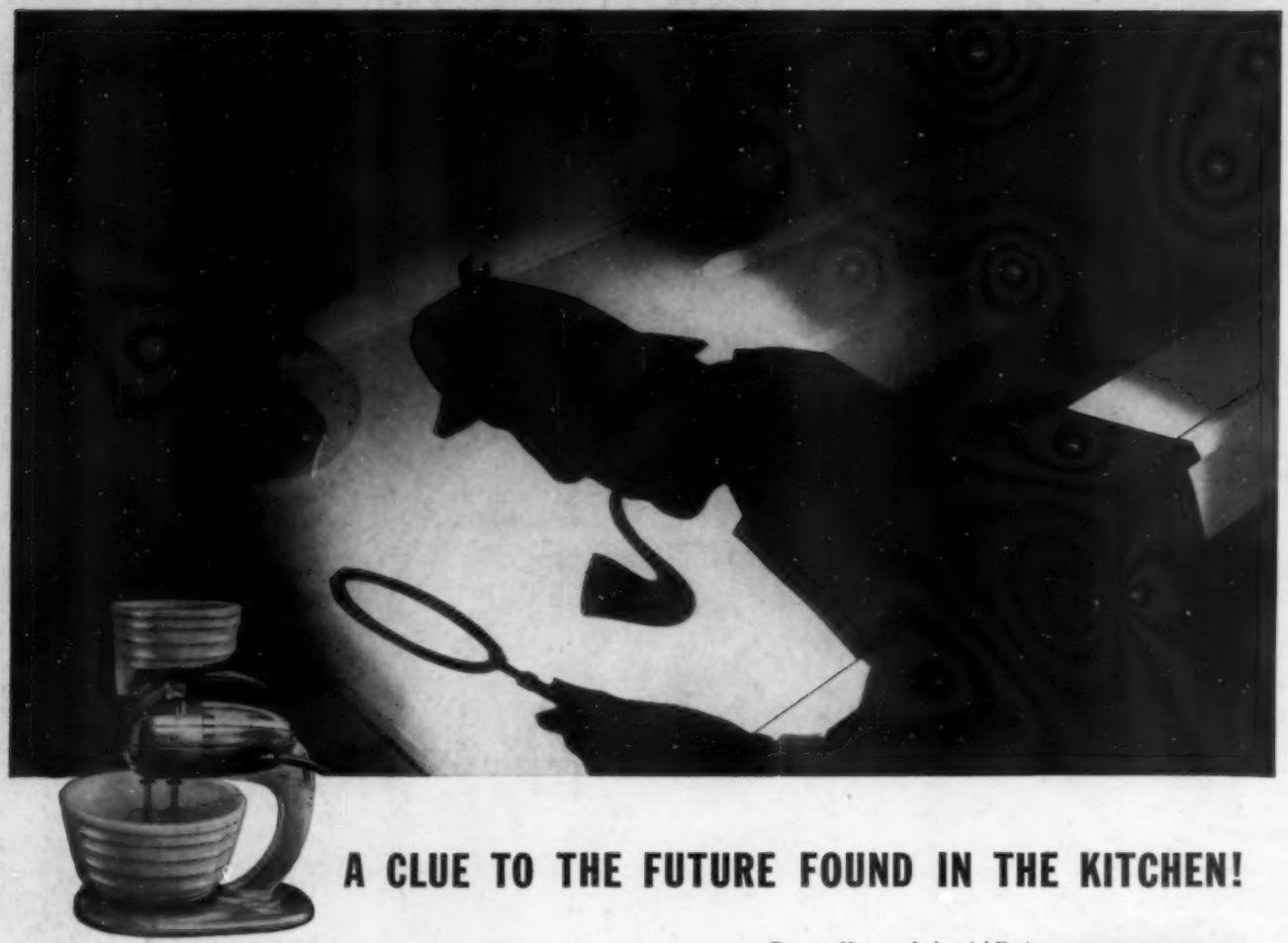
TECHNOLOGY DEPT.

First Copy

MODERN PLASTICS

JUNE 1942



A CLUE TO THE FUTURE FOUND IN THE KITCHEN!

ROBERT HELLER, *Industrial Designer*

FOCUS ON THE ELECTRIC MIXER . . . you're getting warm! Of course it squeezes orange juice and whips up cake batter . . . so what?

What can this mixer reveal to you about America's future? Concentrate on its elegantly streamlined motor housing . . . *there's* your clue. But suppose we let Robert Heller explain its significance . . .

"In redesigning the Gilbert Kitchen-Kit, the aim was to use plastics, not only because they add so much aesthetically to a product, but also because they offer major manufacturing economies on a mass-production basis. At first, plastics couldn't be 'engineered' . . . motor heat and vibration ruined each plastic housing that was tried. Finally, we solved the problem with a special Durez plastic of extremely high heat resistance and tensile strength. In the engineering world . . . this meant plastics had passed another milestone on the road to the future. For this radially-designed Durez plastic housing eventually will be applied to many kinds of motors with corresponding increases in efficiency and production savings."

Here is the biography of what you might be pleased to call a simple kitchen gadget. Yet it explains the part that plastics will play in developing America's post-war economy . . . *after* they have contributed their share in helping to win the war. As the war-effort rolls on . . . new Durez phenolic molding compounds, phenolic resins, new formulae emerge from our laboratories . . . headed straight for the military production lines. These constant improvements in plastics are vital to all industry which must plan for America's peace. Would you like to keep pace with developments? A request on your letterhead will bring you *Durez Plastics News.*

DUREZ . . . plastics that fit the job

DUREZ PLASTICS & CHEMICALS, INC. DUREZ 1126 WALCK ROAD, N. TONAWANDA, N. Y.

CONSERVE
WITH *Catalin*

Cast PHENOLIC RESINS

"Catalin" a thermosetting resin, is supplied in fully cured shapes. Three distinct casting processes are now available, allowing complete freedom of design using straight draw molds without undercuts . . . split molds with undercuts . . . and cored molds to obtain compound curves, half-spherical and full-spherical hollow castings.

Liquid RESINS

"Catabond" and "Catavar" identify a wide variety of formulations employed in coating, laminating, glueing, bonding and impregnating wood, plywood, abrasives, paper, sisal, cork, etc. Currently of tremendous importance to the aircraft industry, these Catalin Liquid Resins are effecting drastic changes and economies in products and processes.

POLYSTYRENE *Molding* COMPOUNDS

"Loalin" is Catalin's perfected thermoplastic molding compound. "Zero"-water-absorbtion, high dielectric strength, excellent chemical resistance, unrivalled dimensional stability and 90% light transmission make this lightest in weight of all the plastics one of the most desirable. "Loalin" flows freely . . . speeds curing cycles.

WHERE time, money or precious metal is a factor, *conserve* with Catalin! This versatile thermosetting plastic requires no expensive time-consuming molds or molding equipment . . . is equally adaptable to small or large quantity production. • Catalin is strong, non-inflammable, non-water absorbent, resistant to oils and acids. These desirable physical properties make it an ideal material for applications such as the precision machine-tool control knobs and wheels pictured above. • Whether machined from stock rods, tubes or sheets, or cast to special shapes, Catalin parts and devices can be found today in many important positions on the home "production front" as well as on "active duty" with our armed forces. Our engineers and chemists will be glad to show you how Catalin, or any other member of our plastic family, can help solve *your* problem.

CATALIN CORPORATION • ONE PARK AVENUE, NEW YORK, N. Y.

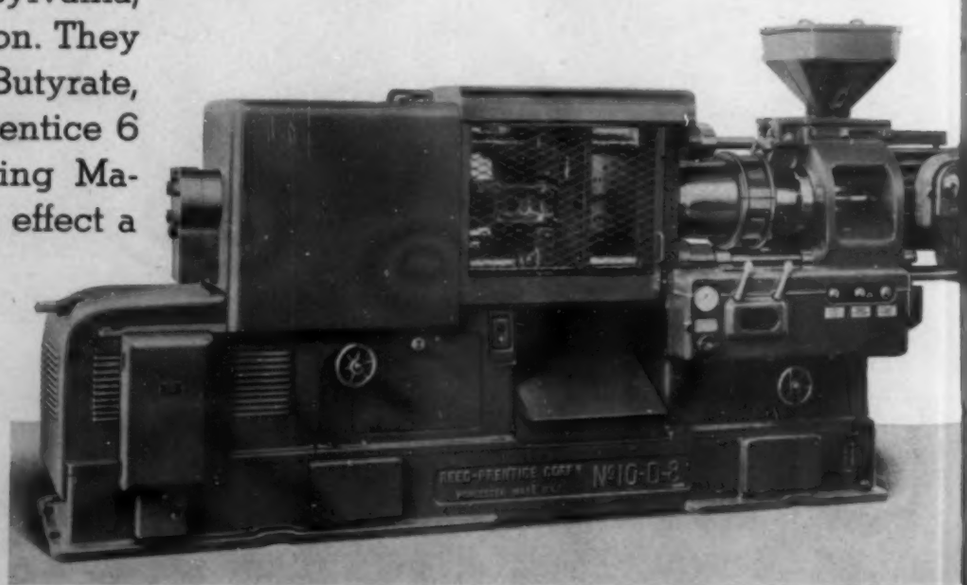
Catalin

Reed-Prentice Machines Mold NEW Curtiss Dials and Knobs

Below: The same group as they appear when exposed to ultra-violet electronic black light.

Day after day, plastics are playing an increasingly important part in releasing vital metals for our Victory effort. The airplane instrument panel dials as shown were molded by the Erie Resistor Corporation of Erie, Pennsylvania, for the Curtiss-Wright Corporation. They are made of Cellulose Acetate Butyrate, and are molded on a Reed-Prentice 6 ounce Plastic Injection Molding Machine. These dials and knobs effect a 50% saving in weight over similiar metal parts.

The speed of production on Reed-Prentice machines assures that there will be no lagging when plastic parts are needed to meet important schedules. Reed-Prentice Plastic Injecion Molding Machines with capacities of four, six and eight ounces are available.



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modern plastics

JUNE 1942

VOLUME 19 NUMBER 10

WASHINGTON NOTE

Of interest to the industry will be the chart on page 92, which gives the tentative set-up of the Chemicals Branch of the Materials Division, WPB. A news item on the facing page gives further detail on the organization of the Plastics and Resins Section and its three Units; and lists the men now assisting the heads of these Units, many of whom are known to members of the plastics industry. MODERN PLASTICS will keep its readers informed of any revisions made in the structure of the Chemicals Branch.

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Visible to the enemy?..Not by a bombsight

CAMOUFLAGE, through a bombsight at ten thousand feet, looks like the rest of the terrain. It prevents enemy observers from learning where they will run into trouble, or how much power is amassed against them.

And it is to prevent this same kind of information from getting into the wrong hands that details, specifications, and uses of many plastic products must be kept "under cover." Suffice it to say that plastic war products are being produced in large quantities—and new products are being created which will give the Axis trouble—and lots of it.

Richardson Plasticians, in addition to co-operating with war equipment designers to develop new parts and products, are helping many manufacturers increase their output per machine-hour. If you have a problem which molded or laminated plastics might solve, we will be glad to give you the details and characteristics of INSUROK Precision Plastics.

• • •

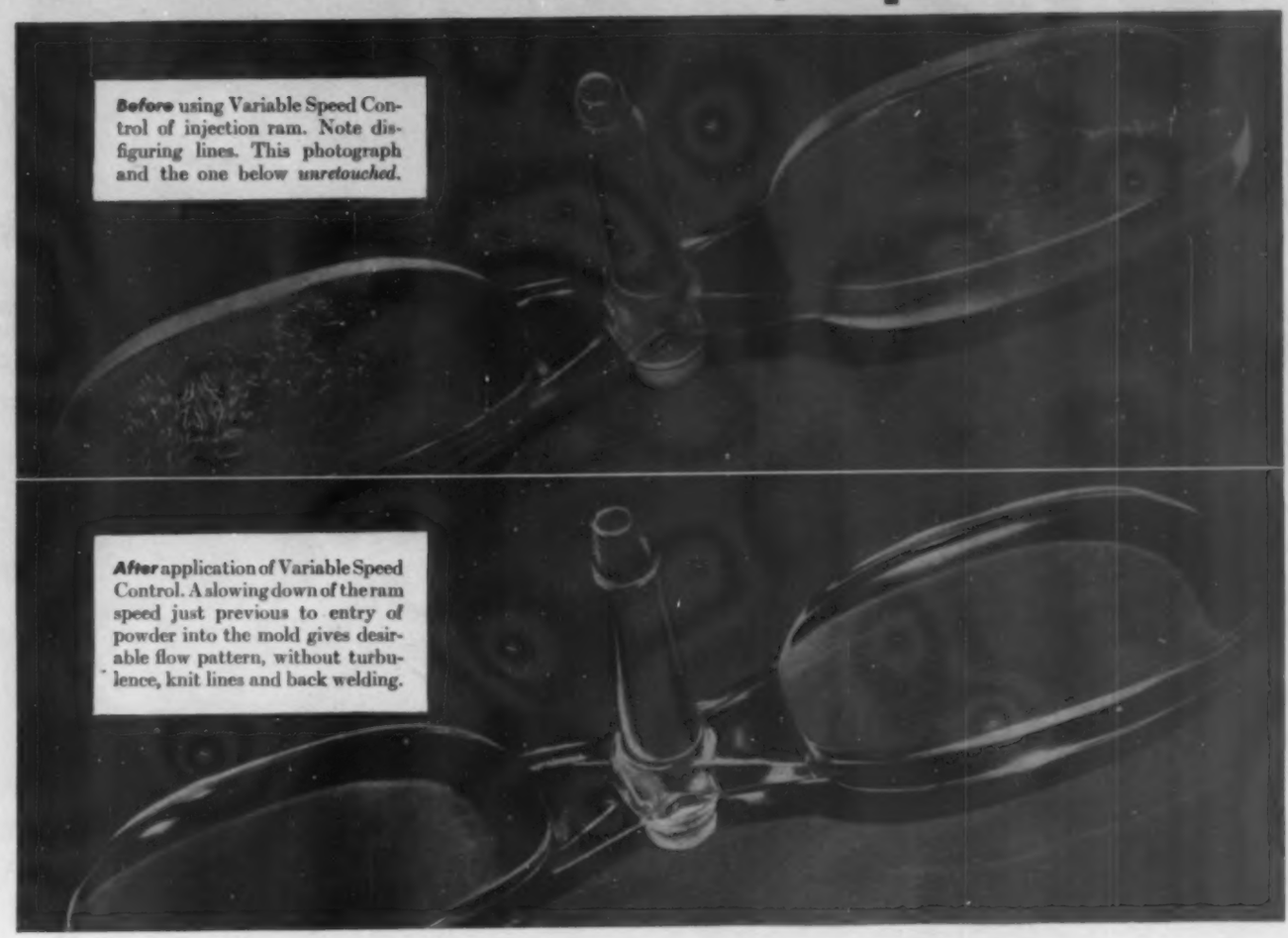
The Richardson Company, Melrose Park, Ill.; Lockland, Ohio; New Brunswick, N. J.; Indianapolis, Ind. Sales Offices: 75 West St., New York City; G. M. Building, Detroit.

INSUROK *and the experience of Richardson Plasticians are helping war products producers by:*

1. Increasing output per machine-hour.
2. Shortening time from blueprint to production.
3. Facilitating sub-contracting.
4. Saving other critical materials for other important jobs.
5. Providing greater latitude for designers.
6. Doing things that "can't be done."
7. Aiding in improved machine and product performance.

INSUROK

How "Variable Speed Control" Saves Man Hours and Materials, Improves Yields



Before using Variable Speed Control of injection ram. Note disfiguring lines. This photograph and the one below *unretouched.*

After application of Variable Speed Control. A slowing down of the ram speed just previous to entry of powder into the mold gives desirable flow pattern, without turbulence, knit lines and back welding.

Du Pont Technical Committee

helped develop this major new molding technique

FOR A LONG TIME, a way has been sought to up yields, mold large objects, and improve the strength and good looks of injection molded products. Here's a technique developed to do it at low cost! It's called Variable Speed Control of the injection ram.

This outstanding recent achievement in plastics has come about by the mutual efforts of molders, machine manufacturers and the *Du Pont Technical Committee.*

Consider these important benefits made possible for many types of moldings: Partial or complete elimination of disfiguring knit lines, weld marks, turbulence and bubbles . . . greater strength and uniformity . . . thicker and larger sections . . . greatly increased yield . . . material savings by shortened trial runs . . . mold alteration often eliminated. And it's easily applied to standard injection machines without interfering with normal machine operation. This brings a major improvement in the molding of products for manufacturers who are using plastics.

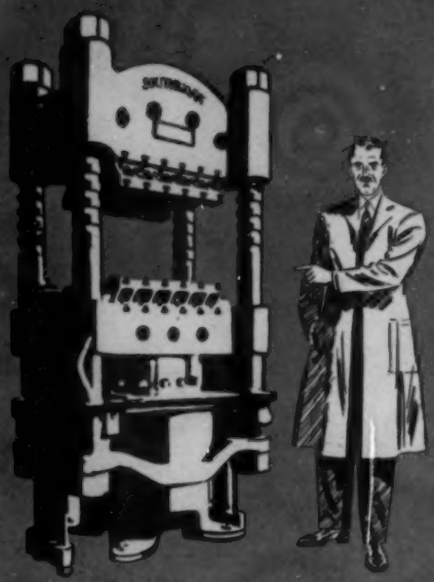
This is only one of the new things in plastics that Du Pont research and the *Du Pont Technical Committee* have assisted in making possible. Du Pont has not only brought out new materials such as "Lucite," nylon, and other plastics. It has actively assisted molders, fabricators, designers and users in making the most of them in way of useful, profitable articles. Today, of course, this skill is being devoted to war plans and production. Write the Du Pont Technical Service. Help is still on tap if you need it. E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J.

DU PONT

REG. U. S. PAT. OFF.

PLASTICS

"Lucite" methyl methacrylate resin
"Plastacele" cellulose acetate plastic
"Pyralin" cellulose nitrate plastic



for

stronger,

LARGER

molded pieces

. . . . install Southwark Hydraulic Presses

Increased requirements for molded articles call for presses *rugged* enough to stand production demands placed upon them, *accurate* in performance to maintain highest quality, and economical in operation and maintenance so that unit cost can be kept low. To meet these demands, Southwark engineers have developed powerful presses for molding stronger and larger pieces.

The press illustrated is but one of many types of Southwark hydraulic steam platen presses engineered to meet today's requirements in rubber and plastics manufacture. When you're planning new plant equipment for the competition of tomorrow it will pay you to specify Southwark.

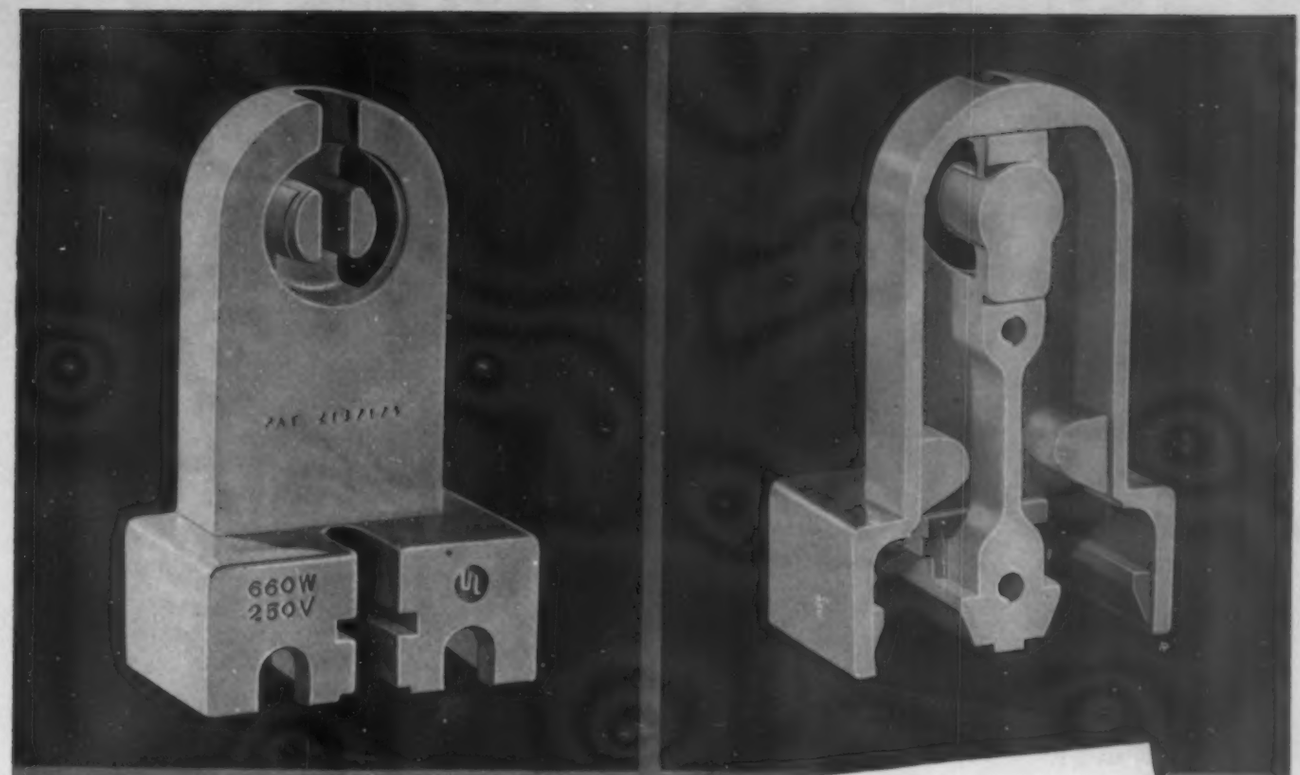
Southwark hydraulic molding presses have proven their reliability, have shown the way to reduced production costs, have helped many a company do a better job—more economically.

BALDWIN

Southwark

BLW THE BALDWIN GROUP

DIVISION OF THE BALDWIN LOCOMOTIVE WORKS • PHILADELPHIA



LUMARITH *is approved material*

As a result of the Underwriters' Laboratories wartime work of investigating materials, Lumarith has been accepted for lamp-holders for fluorescent lamps and attachment plug caps.

THE ever-widening scope of Lumarith applications is due to the fact that not only is Lumarith unsurpassable in its own numerous fields—but as shortages of other materials crop up, Lumarith is found to be the ideal replacement. In dielectric strength, toughness, and ease of processing, Lumarith has advantages that suggest immediate investigation by electrical designers and manufacturers.

Our technical staff will gladly supply the data you want—plus active cooperation in development work, if needed. Celanese Celluloid Corporation, 180 Madison Ave., New York City, a Division of Celanese Corporation of America. Sole Producer of Lumarith* (cellulose acetate plastics in sheets, rods, tubes, molding powder, transparent film and dope)....*Trademark Reg. U. S. Pat. Off.

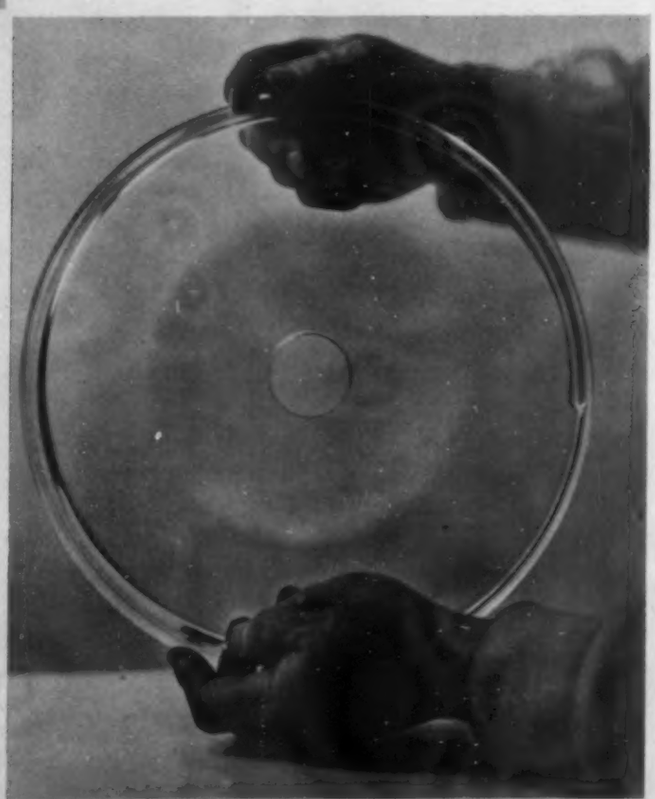
CELANESE CELLULOID CORPORATION

PLASTICS to PROTECT
THE NATION'S MILK SUPPLY

Protecting milk from contamination while cans are being filled, is the vital function of this transparent plastic cover, one of the basic parts of the new Mojonnier Sanitary Foamless Can-Filling Unit. Its careful design prevents moisture from the chilled feed line from entering the can at any time during the filling operation. Its transparency permits the operator to see the level of the milk clearly. It is sanitary and easy to clean; highly resistant to breakage. Molded of methyl methacrylate material for Mojonnier Bros. Co., 4601 West Ohio Street, Chicago.

On the Battle Front—on the Production Front—on the Home Front—plastic parts by Chicago Molded Products Corporation are performing many important tasks in the nation's war economy. Mojonnier Bros. Co. is only one of the many leaders in essential industries who, desiring to realize the advantages of plastics to the utmost, have brought their plastic molding jobs to this organization.

If molded plastics are indicated as a possibility for your application, you are invited to consult us. You will find here unexcelled facilities for engineering, design, mold fabrication and molding by the compression, injection, transfer, and extrusion methods.



CHICAGO MOLDED PRODUCTS CORP.

1046 NORTH KOLMAR AVENUE CHICAGO, ILLINOIS

One Hand Driving • Power Tools • Tighter Assembly = 50% Less Assembly Time with Phillips Screws

B. P. (Before Phillips). Slow-driving slotted screws required two hands to aim the screw and steady the work — and still accidents happened, causing plenty of mangled fingers or scars in the work. Always something going wrong — crooked screws — heads splitting — burrs to remove — loose assemblies. Thank goodness those days are gone forever!

A. P. (After Phillips). Faster-driving Phillips Recessed Head Screws need only one hand . . . the other hand is free for support. No fumbled screws — straight, effortless driving. Even when assembling parts already finished — like enameled, painted or other easily-scratched surfaces — power driving is safe, because there's no danger of driver slippage. And screws can be set up tight without heads splitting or raising burrs.

Your assembly crew will find it "easy as rolling off a log" to produce better work . . . in half the time . . . at a 50% cost saving with Phillips Screws.

For facts and screws write any firm listed below.

PHILLIPS RECESSED HEAD SCREWS

GIVE YOU 2 for 1 (SPEED AT LOWER COST)

WOOD SCREWS • MACHINE SCREWS • SHEET METAL SCREWS • STOVE BOLTS • SPECIAL THREAD-CUTTING SCREWS • SCREWS WITH LOCK WASHERS

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
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Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

There's more to production than just a priority...

A-1-A

YOUR priority number, no matter how high, can guarantee you just one thing—and that is preference. In a molded plastic job, it won't guarantee you production to closest tolerances, nor finishing of the kind that cuts assembly hours to minutes.

That's why, in these days of substitutes, new materials and unpredictable production schedules, it's more important than ever that you have all possible experience to help you solve your plastic molding problems.

Our sixty-six years of molding experience makes a lot of difference, our customers say. One described it as the "engineering skill to do the impossible." That's pretty strong, but perhaps our success with the tough jobs is due to the fact that as pioneers, we have had to figure ways of doing things for ourselves. And that habit has stayed with us.

If your defense job needs special skill, we suggest that it may aid our national program to get in touch with our engineering department.

MOLDED PLASTICS DIVISION OF

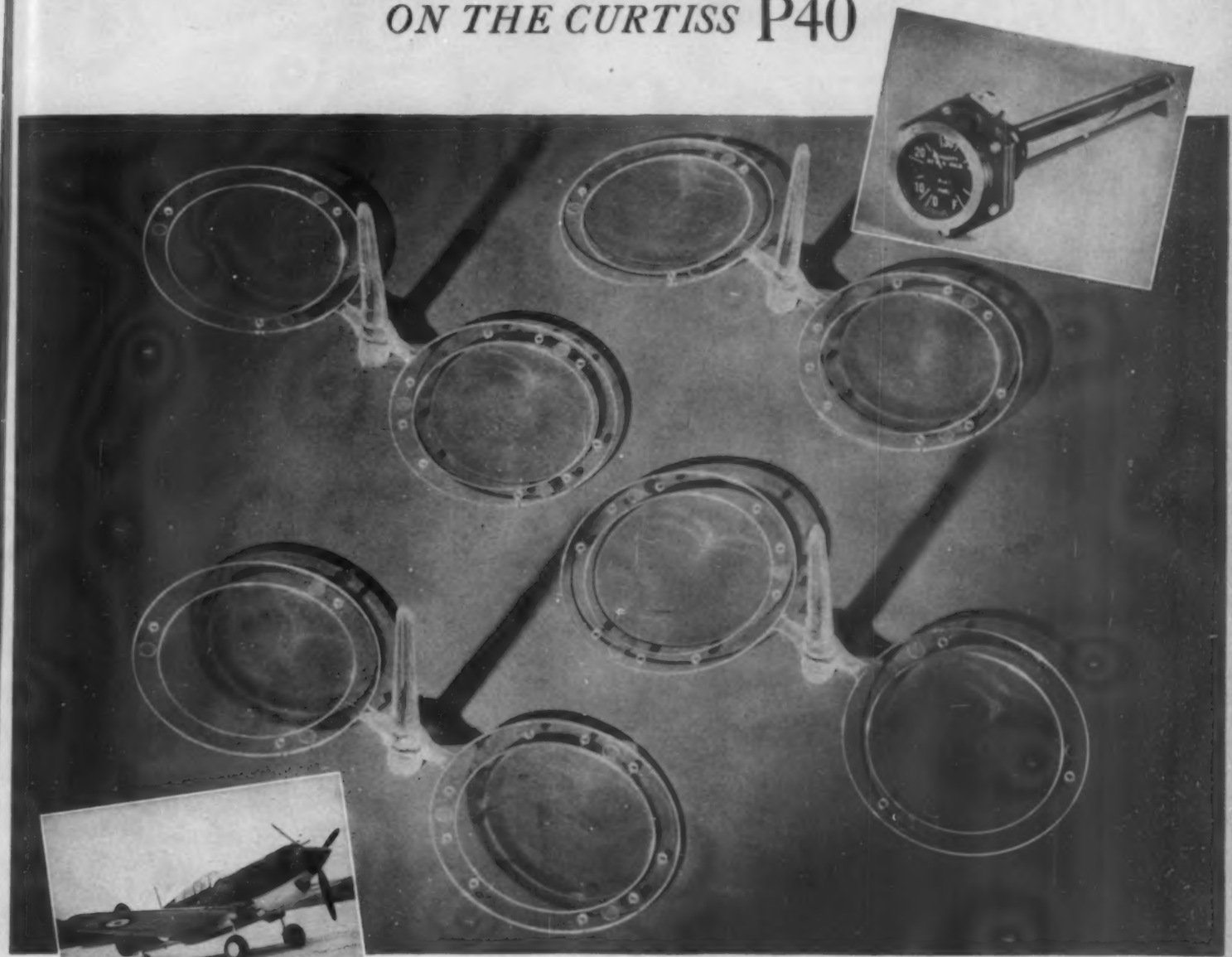
AUBURN BUTTON WORKS

★ **AUBURN, NEW YORK** ★

Molders of all types of Thermo-Setting and Thermo-Plastic materials by compression, injection and extrusion methods

Crystalite gauge windows

ON THE CURTISS P40



Two by two, complete with mounting holes and ready for installation, these transparent CRYSTALITE parts are marching from General Electric's injection presses off to war. As windows on Boston Gauge Company's fuel gauges, they will shortly be quartered on Curtiss P-40's. For this service they are ideally suited by reason of their permanent clarity, light weight and high impact strength.

Actually clearer than glass and less than half as heavy, CRYSTALITE gauges, gauge and inspection windows are today preferred for many military instruments. They can be quickly produced in great quantities and efficiently made. They stand rough treatment without injury and thus reduce breakage due to careless installation. The use of transparent CRYSTALITE also provides important savings in weight and results in simplified assembly operations.

For further information on CRYSTALITE injection and compression moldings, ask to have a Rohm & Haas representative call.

THE CRYSTAL-CLEAR ACRYLIC PLASTICS

PLEXIGLAS

SHEETS AND RODS

★

CRYSTALITE

MOLDING POWDER

PLEXIGLAS and CRYSTALITE are the trade-marks, Reg. U. S. Pat. Off., for the acrylic resin thermoplastics manufactured by the Rohm & Haas Company.

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.

Manufacturers of Leather and Textile Specialties and Finishes . . Enzymes . . Crystal-Clear Acrylic Plastics . . Synthetic Insecticides . . Fungicides . . and other Industrial Chemicals

THIS ISSUE OF MODERN PLASTICS CONTAINS THE SECOND SERIES OF NEWS REPORTS FROM OUR NEW WASHINGTON BUREAU

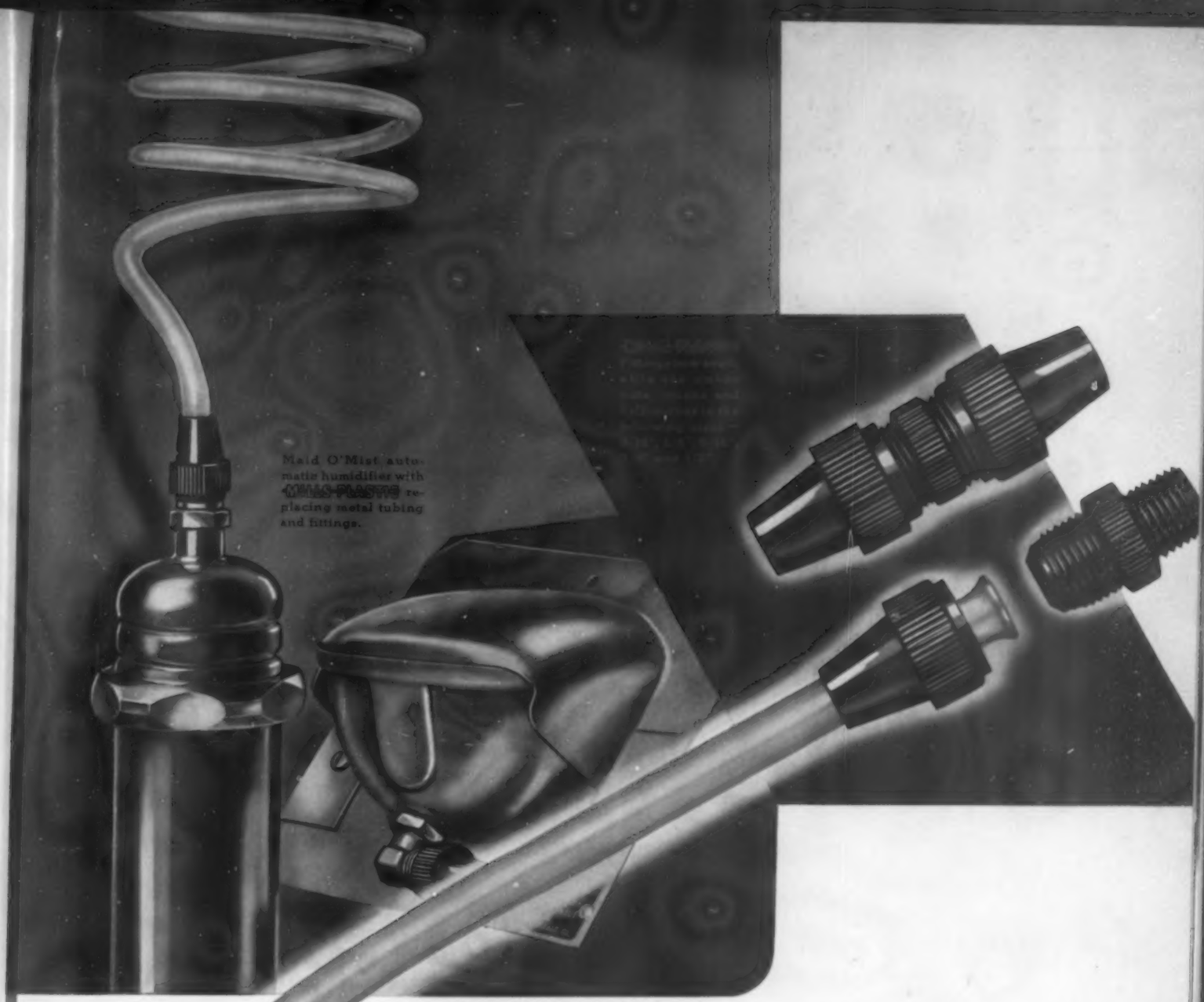
ON PAGE 92

Modern Plastics has added one more service to its full coverage of plastics by opening a special Washington Bureau under the direction of Raymond R. Dickey, ace journalist who is completely familiar with "on the spot" newsgathering in the nation's capital.

The Washington News section of Modern Plastics will contain facts, "official rumor" and authoritative opinion reflecting on the plastics situation. It will be published as long as newsworthy data are available. Subscriptions for Modern Plastics, the only magazine completely devoted to these modern materials, is still

$5.....per year
$5.50.....in Canada
$6.....foreign

MODERN PLASTICS
122 East 42nd Street New York City



Maid O'Mist automatic humidifier with MILLS-PLASTIC replacing metal tubing and fittings.

A FITTING *Introduction*

Almost simultaneously with the announcement of MILLS-PLASTIC Tubing comes the introduction of MILLS-PLASTIC Fittings. These fittings were designed and engineered to replace metals so necessary to our all-out war effort. In nearly every case, because of resistance to most chemicals and flexibility of handling, MILLS-PLASTIC Fittings will do the job better and with greater economy. Each flare fitting is precision injection molded in multiple unit production, cutting costs and assuring uniformity of specification. Threads are molded for uniformity, face knurled for surer grip and materials strengthened for high working pressures. MILLS-PLASTIC Fittings and MILLS-PLASTIC Tubing are solutions to your war production problems. Consult our engineers . . . there is no obligation.

Your signature on your letterhead brings you a copy of this catalog containing data and illustrations of molded thermoplastics . . . and MILLS-PLASTIC

MILLS-PLASTIC

*Trademark of the Dow Chemical Co.

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite, Polystyrene, Styron, Lustron, Loalin, Vinylite, Mills-Plastic, Saran and other Thermoplastic materials.

812 WEST VAN BUREN STREET • CHICAGO, ILLINOIS

SHAKEPROOF
Thread-Cutting Screws
FOR *Plastics*

With the aid of polarized light, a Shakeproof Engineer studies the stresses caused by various types of screws when driven into plastics.

FREE SAMPLE TEST KIT!
Contains samples of Types 2, 9 and 25 Thread-Cutting Screws in a variety of sizes. Write for yours now!

EVERY *Plastic* FABRICATOR SHOULD READ THIS BULLETIN!

Today, when speed and efficiency in the fastening of plastic parts is vital, this new bulletin on Thread-Producing Screws should prove extremely helpful. It features the reprint of the article prepared by a Shakeproof research engineer for the January issue of Modern Plastics and, in addition, presents other detailed technical data on the use of Shakeproof Thread-Cutting Screws in various types of plastics. Anyone who is responsible for the fastening of plastic parts should send for a copy of this bulletin. Also, be sure to ask for a free sample test kit of Shakeproof Thread-Cutting Screws for Plastics. Write us today!

SHAKEPROOF inc.
fastening Headquarters

Distributor of Shakeproof Products Manufactured by ILLINOIS TOOL WORKS
2501 NORTH KEELER AVENUE • CHICAGO, ILLINOIS
Plants at Chicago and Elgin, Illinois
In Canada: Canada Illinois Tools, Ltd., Toronto, Ontario

SEMS FASTENER UNITS • LOCK WASHERS • LOCKING AND PLAIN TERMINALS • THREAD-CUTTING SCREWS • LOCKING SCREWS
SPRING WASHERS • RADIO AND INSTRUMENT GEARS • COWL FASTENERS • SPECIAL STAMPINGS

Liquid Resins

We can make your resin solutions for coating, impregnating, bonding, insulating, etc., to your specifications or formula.

Our facilities include many large and small condensing and distilling kettles capable of producing various types of resins in liquid form.

If you are engaged in vital production work and need a reliable source for resin solutions, get in touch with us promptly.

Marblette Corporation

37-21 Thirtieth Street
Long Island City, New York
Sales Offices — Chicago • Los Angeles • Toronto • Havana

NO *maps*

Once we ran a map in our advertisement, showing how easy it was to drive out to Boonton.

(remember when you could drive anywhere, just for fun? remember when you could tell everybody where your plant was located?)

NO *visits*

Once we used to ask any interested party to visit our plant, any day, any time.

(remember when you could do that without badges, birth certificates and fingerprints?)

NO *lunches*

Once we used to invite potential customers out to lunch.

(remember when you didn't eat at your desk?)

LITTLE enough to give up for the duration, these niceties. One thing we haven't changed—and so help us, we never will—and that is our way of doing business which these things were symptoms of. We've always been friendly with our customers. We're even good friends with our competitors. Come peace, we'll invite you all out for a picnic, lunch, visit—and all the plastic moldings you want!

"A Ready Reference for Plastics" written for the layman, is now in a new edition. If you are a user, or a potential user of molded plastics, write us on your letterhead for a copy of this plain non-technical explanation of their uses and characteristics.

BMCO

BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO-PLASTICS

BOONTON · NEW JERSEY · Tel. Boonton 8-0991

N. Y. Office—Chanin Bldg., 122 East 42nd Street, Murray Hill 6-8540

Nixon Ethyl Cellulose Plastics

LIGHTEST of the Nixon cellulose plastics, Nixon Ethyl Cellulose, because of its remarkable combination of properties, is proving its utility in many high-priority applications.

The outstanding characteristics of Nixon's Ethyl Cellulose Plastics are:

1) Retention of Flexibility at low temperatures—Flexibility at −70° F. is a known characteristic of this plastic.

2) Outstanding Light Stability—All accelerated aging tests have proven this material to be very resistant to light exposure.

3) Excellent Heat Resistance—Very resistant to degradation under molding temperatures.

4) Excellent Electrical Properties—The dielectric properties bring about a demand for this product in the electrical field.

Water Resistance, low specific gravity (1.15), high tensile strength, high softening point, unusual toughness and flexibility are other characteristics that make Nixon Ethyl Cellulose Plastics an important element in our Victory program.

Nixon Ethyl Cellulose plastic can be furnished as a molding powder in proper formulations suitable for injection molding, compression molding and extrusion, as well as sheets, rods and tubing. *If your production carries high priority rating*, and you require a material with these characteristics, get in touch with us for samples and detailed information.

NIXON PLASTICS

NIXON NITRATION WORKS, INC.
Mfrs: NIXON ACETATE MOLDING POWDERS • NIXONITE (acetate) and NIXONOID (nitrate), sheets, rods, tubes
NIXON . . . . NEW JERSEY

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1219 No. Austin Blvd., Chicago, Ill.
phone Esterbrook 4242

C. B. JUDD
401 Loudermann Bldg., St. Louis, Mo.
phone Chestnut 8495

W. S. MOWRY
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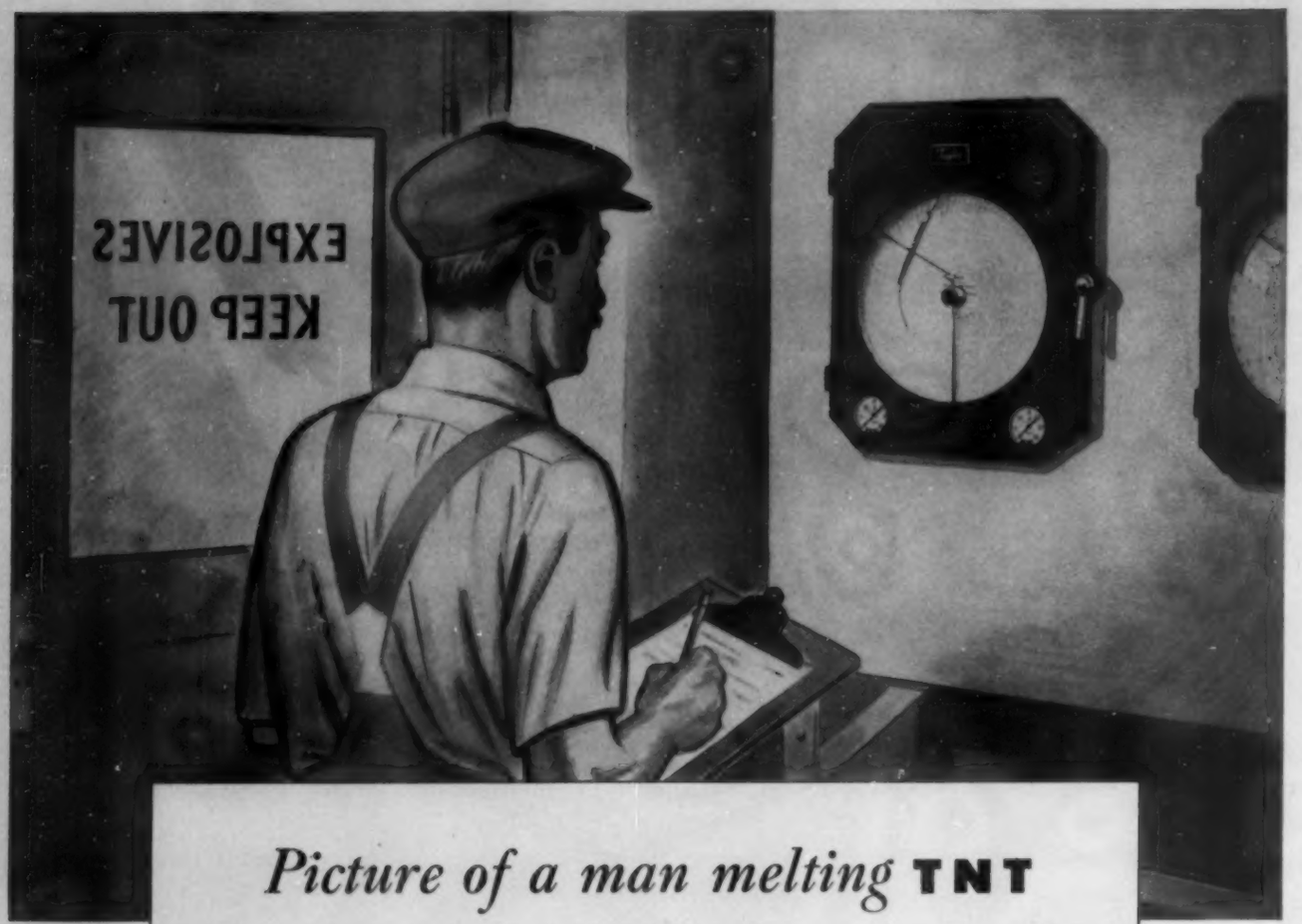
phone Springfield 4-7121

A. F. PERRY
Leominster, Mass.
phone Leominster 1011

CHANTLER & CHANTLER, LIMITED
Toronto, Ont., Canada
phone Elgin 5215

[Another advertisement telling how different American Industries are speeding up Wartime Production]



Picture of a man melting **TNT**

How Taylor Automatic Control helps the Chemical Industry in Wartime

TNT is one of the most important high explosives used for bursting charges in military shells. A common method of shell filling is to heat the TNT (which resembles brown sugar at normal temperatures) to just above its melting point and pour it directly into the shell, or into a form of the required shape.

This sounds dangerously interesting to the layman, but it is a relatively simple process-control job compared to some of its preliminary stages such as the nitration of toluol.

The manufacture of TNT is typical of hundreds of operations where Taylor instruments are speeding production and improving quality for America's vital chemical industry. Whether the process involves melting, distillation, evaporation, or drying, Taylor Field Engineers can analyze the problem and specify the best instruments for the purpose.

The development of synthetics such as nylon, transparent plastics, and phenolic resins could hardly have been possible without the aid of indicating, recording, and controlling instruments. The ethylene glycol that is the life-blood of liquid-cooled airplane engines depends on automatic temperature, flow, and pressure-controlling instruments for its production.

Whatever you make, you can benefit from Taylor experience. The Taylor Field Engineer in your territory can help you improve quality and increase production. He can help you prevent waste, avoid accidents. He can show you how to step up production without adding men, machinery, or floor space. He can help train your men in the operation and maintenance of essential Taylor instruments.

YOUR TAYLOR FIELD ENGINEER is anxious to help you do your part toward winning the war. What's more, he's thoroughly equipped for the job! With his years of training and experience, backed by the engineering and research facilities of the entire Taylor organization, he stands ready to help solve your problem. Call him in. Or write to us—and we'll send him to see you. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. Makers of the famous "Not 1 but 5" Fulscope Controllers.

SULFA DRUGS PLASTICS EXPLOSIVES ETHYLENE GLYCOL CHLORINE

Taylor

Indicating Recording Controlling

TEMPERATURE, PRESSURE, FLOW *and* LEVEL INSTRUMENTS

Housing the nerves of direction

Radio compass antenna-housing molded by Czecho Peasant Art Co., from a plastic based on Hercules Cellulose Acetate Flake.

A TOUGH PLASTIC DOES THE JOB

That streamlined projection you see on bombers and commercial planes houses the loop antenna that picks up the beam that guides aircraft.

STRENGTH: A plastic based on cellulose acetate makes these housings tough to resist the impacts of rough handling, and the eroding forces of tiny particles and rushing air at 400 miles an hour. It is lightweight. It is waterproof—molded in one piece. And it withstands temperature, humidity, and pressure, which change rapidly from one extreme to another.

VERSATILE: Cellulose acetate adapts itself readily to this as to countless other uses. Its versatility makes it the ideal base for molding powders from which millions of useful parts and finished articles are produced economically and at great speed for war and for peace.

MANY ADVANTAGES: We do not make plastics, but by long research we have helped to give cellulose acetate its many advantages—and we continue to improve it. To get these advantages, specify plastics formed from molding powders made with a base of Hercules Cellulose Acetate Flake. Write Dept. MP-6.

DDD-46

HERCULES

CELLULOSE ACETATE

HERCULES POWDER COMPANY Incorporated · WILMINGTON, DELAWARE

THIS Tough MODERN MATERIAL

STANDS UP TO MANY KINDS OF GRIEF

CIGARETTE BURNS

Cigarette-Proof Formica is never Spotted by Smokers.

COFFEE STAINS

The Material is Non-Porous and will not absorb Stains.

FRUIT ACIDS

Fruit Acids won't hurt; it's chemically inert.

WASHING SOLUTIONS

Alkaline Washing solutions do not attack the Finish.

WEAR

It will stand years of wear and friction.

NOT BRITTLE

Sharp Blows will not Crack or Chip the Formica.

Formica is a modern surfacing material, produced by chemical research to provide a combination of qualities that would meet and conquer conditions that have been fatal to most of the older materials.

A few of these hazards are illustrated, but there are others—such as alcohol, cosmetics, wet umbrellas, ink—all equally harmless to Formica.

This exceptionally sturdy finish comes in a wide range of deep beautiful colors, and patterns. Genuine wood veneers of fine woods, like mahogany, sapeli, avodire, and many others are introduced and in Formica "Realwood" attain the same indifference to abuse. Inlays of one color over another make a wide range of designs possible.

That's why Formica has been so widely used for tough jobs by leading designers of ships, trains, hotels, libraries, public buildings, restaurants, soda fountains.

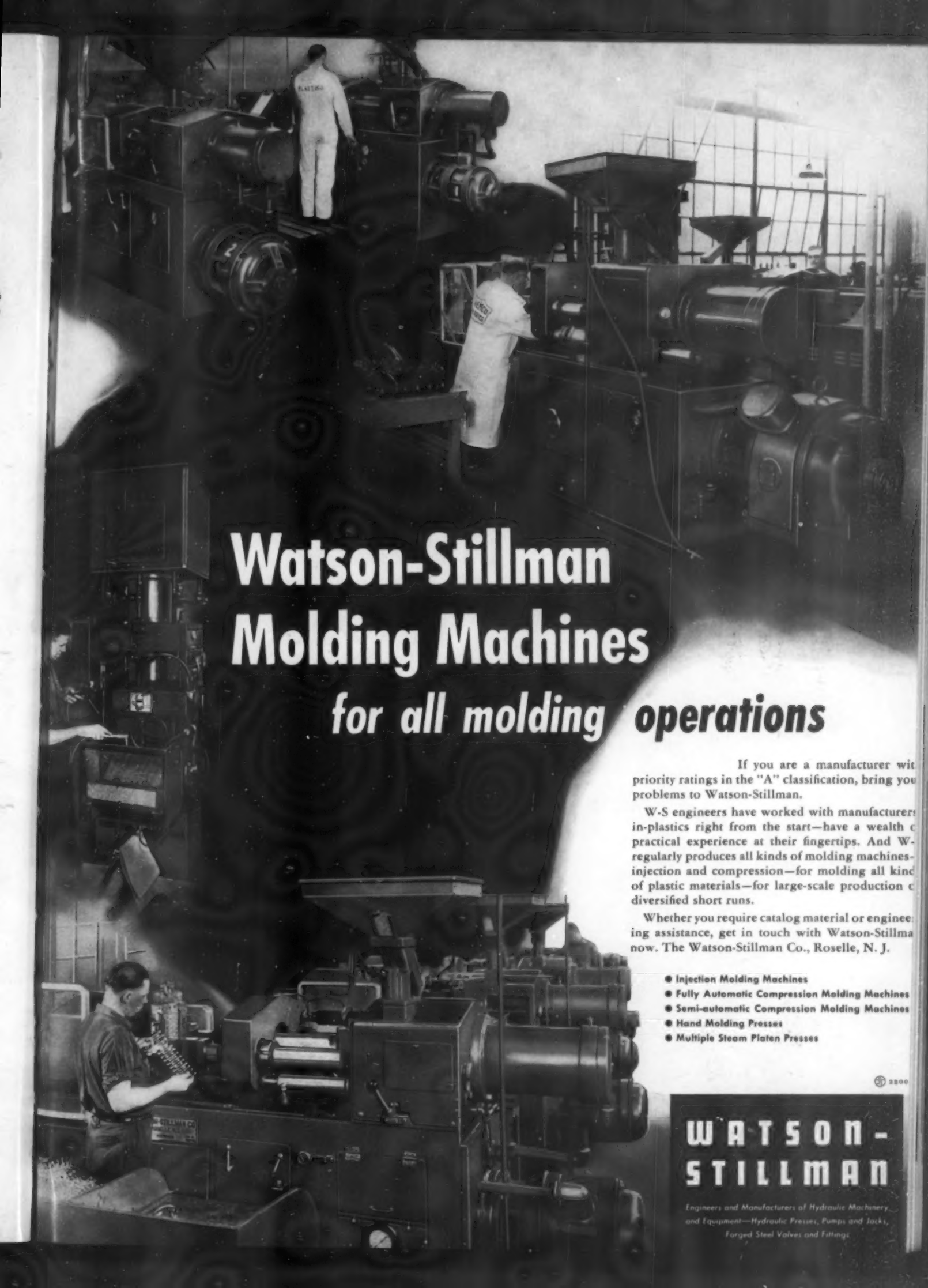
Color charts and installation details on request.

FORMICA

THE FORMICA INSULATION COMPANY

4673 SPRING GROVE AVENUE

CINCINNATI · OHIO



Watson-Stillman Molding Machines

for all molding operations

If you are a manufacturer wit priority ratings in the "A" classification, bring you problems to Watson-Stillman.

W-S engineers have worked with manufacturers in-plastics right from the start—have a wealth o practical experience at their fingertips. And W- regularly produces all kinds of molding machines- injection and compression—for molding all kind of plastic materials—for large-scale production o diversified short runs.

Whether you require catalog material or enginee ing assistance, get in touch with Watson-Stillma now. The Watson-Stillman Co., Roselle, N. J.

- **Injection Molding Machines**
- **Fully Automatic Compression Molding Machines**
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- **Hand Molding Presses**
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2800

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Engineers and Manufacturers of Hydraulic Machinery and Equipment—Hydraulic Presses, Pumps and Jacks, Forged Steel Valves and Fittings

EXTRUDED PLASTICS, INC.

NORWALK, CONN.

announce the appointment of

DUPLATE CANADA, LTD.

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AS EXCLUSIVE LICENSEES FOR THE CONTINUOUS EXTRUSION OF PLASTIC *INTERLOX*,* FUNCTIONAL SHAPES, AND SEAMLESS TUBING, IN THE DOMINION OF CANADA AND NEWFOUNDLAND

* *Patents Pending.*

IT CAN'T HAPPEN HERE

New window panes of reinforced Vuelite can end the danger of flying glass

WHEN air raid sirens screamed in England, work stopped at machines set near windows . . . for concussion from even a distant bomb would fill the air with deadly slivers of flying glass.

To end that menace here and keep vital machines at peak production even under the threat of enemy bombs, Monsanto in collaboration with the United States Navy has developed this window pane of standard, sixteen-mesh wire screening laminated with Vuelite, the transparent cellulose acetate widely used for lighting fixtures.

Unlike the types of plastic-coated cloth and wire previously used to replace "bombed out" glass in England, the new reinforced Vuelite is as clear and transparent as a screened window of glass and it can be easily installed in any conventional, multi-paned steel or wood sash.

Most important of all, however, it is tough and strong enough to withstand the blast of a 150-pound bomb exploded just eight feet away!

Tested under vacuum shock conditions, it stood up without appreciable damage under a 28-inch vacuum, while clear glass shattered at 15 inches and heavy, wire-reinforced glass at 26. In further tests at the Navy's Bureau of Yards and Docks, a quarter-pound ball dropped from a height of 20 inches smashed ordinary glass while it took a two-pound ball from a height of 42 inches to penetrate a pane of reinforced Vuelite. Even then, the missile left a clean-cut hole which could be repaired with cellulose tape with very little loss in breakage resistance over a solid piece.

Reinforced Vuelite will be supplied in drawn panels .03″ thick in sizes to fit standard multi-paned sash, with a quarter-inch flange for fastening to the window frame, but it can also be drawn or formed to special shapes.

Already being purchased by the Navy for use in war areas, reinforced Vuelite should prove highly useful in troop barracks, air fields, and vital industrial plants in potential air-raid zones and in certain types of military equipment. MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Massachusetts.

MONSANTO PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

The Family of Six Monsanto Plastics

(Trade names designate Monsanto's exclusive formulations of these basic plastic materials)

LUSTRON (polystyrene) • OPALON (cast phenolic resin)
FIBESTOS (cellulose acetate) • NITRON (cellulose nitrate)
SAFLEX (vinyl acetal) • RESINOX (phenolic compounds)

Sheets • Rods • Tubes • Molding Compounds • Castings
Vuepak Rigid Transparent Packaging Materials

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Each member of the staff of Plastics Institute is a recognized authority—a man of broad experience in the practical application of plastics. These men are selected both for their knowledge and their ability to impart this knowledge to others through instruction.

M. J. Rakos
Detroit

A Basic Knowledge of Plastics—LESSON ASSIGNMENTS

You can learn about plastics in your spare time NOW—at home as well as in Forum Classes. Basic Lesson Assignments, written by the staff at Plastics Institute, bring you clear, crisp definitions of the different types of plastics materials. Many actual samples of these plastics are included with the lessons for you to see—and test—right in your own home.

The machinery and methods of the plastics industry are clearly pictured and carefully described in these Basic Lesson Assignments. Brief examinations enable us to tell you each week just how you are progressing in your education in plastics.

This Plastics Course makes smart easy reading for spare evenings at home. Profitable reading, too, because it will give you the technical details of a fast-growing industry.

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PLASTICS

We have had our industrial age, our motorized age, and our age of chemistry. The future belongs to plastics. For plastics will usurp the place of traditional materials now seemingly entrenched by usage. Not alone for transitory war uses, but for civilian requirements after the duration, you will see plastics take the place of steel, aluminum, rubber, bone, natural resins for paints, glass, leathers, and hundreds of unsuspected products now considered vital and irreplaceable!

To meet the inevitable and widening research and testing demands of the coming Age of Plastics, we have perfected the following scientific tests covering every conceivable application of plastics, man's new miracle:

Be prepared. Put your plastics to test now . . . and be ready when the stimulated civilian demand soars to new heights. Inquiries are invited.

- Impact Strength
- Flexural Strength
- Compressive Strength
- Tensile Strength
- Modulus of Electricity
- Distortion under Heat
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- Thickness
- Mold Shrinkage
- Density
- Hot Oil Bath
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- Dielectric Strength
- Insulation Resistance
- Volume Resistivity
- Hardness
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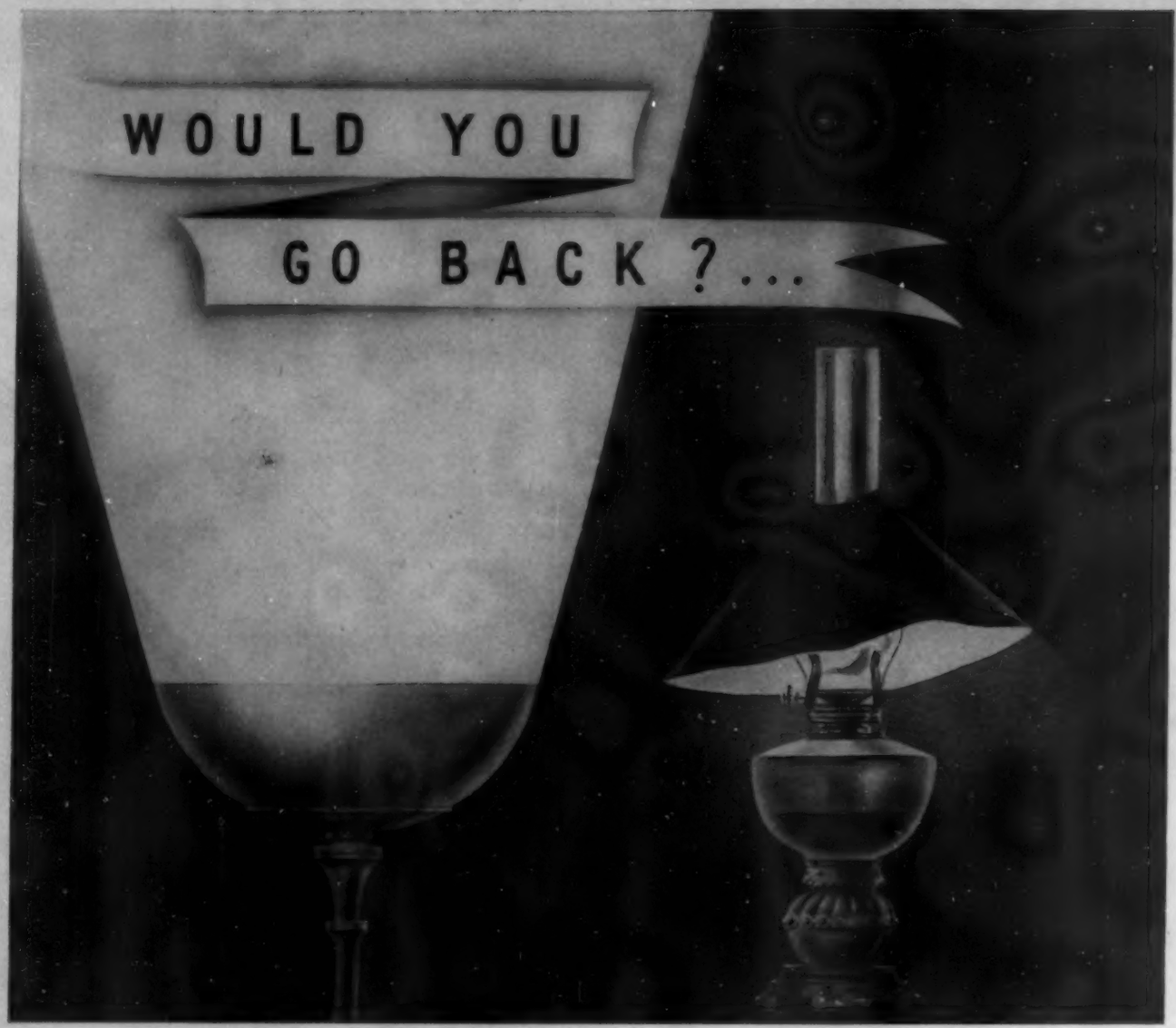
UNITED STATES TESTING COMPANY, INC.

ESTABLISHED 1880

HOBOKEN, NEW JERSEY

PHILADELPHIA, PA. GREENSBORO, N. C. WOONSOCKET, R. I. CHICAGO, ILL. NEW YORK, N. Y.



A BETTERMENT . . .

Not a Substitute

Kerosene lamps were better than the tallow dip . . . The modern electric light is a BETTERMENT over gas for artificial illumination.

Who would want to go back to kerosene lamps?

No more will designers and engineers, who replace weighty—corrosive—costly—hard-to-get materials with engineered CONTINENTAL-DIAMOND NON-metallics, want to go back to the materials replaced.

C-D NON-metallics are not substitutes.

They should and can achieve BETTERMENT of product, process or performance. C-D NON-metallics are better suited to meet many of the material problems of either a war or peace economy than are many habitually used . . . now hard-to-get . . . materials.

C-D NON-metallics offer unique characteristic combinations. For example, DILECTO, one of five C-D NON-metallics, combines high Dielectric Strength, Corrosion Resistance, Light Weight (Specific Gravity 1.36), Resiliency, Moisture Resistance and Adaptability for High Speed, Accurate Fabrication on standard metal-working machinery. The other four C-D NON-metallics offer equally advantageous characteristic combinations.

Get acquainted with all FIVE C-D NON-metallics by sending for Bulletin GF-6. When you are ready to get down to brass tacks on specific problems . . . write, wire or phone us to send around one of our Research Engineers.

Continental-Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911 — NEWARK • DELAWARE

IMPERIAL

Plastic Molding

can help you lick the tough jobs

HERE is one more illustration of how present day designers are making every possible use of plastics to do jobs better . . . to meet the toughest requirements.

The lamp guard shown at the right was produced of impact resisting plastics for Daniel Woodhead Company. It was designed to take advantage of the insulating properties of plastic and yet produce a lamp guard that would stand up under the most severe service.

Engineers of Imperial Molded offered a practical solution to this problem and the lamp guards are now being widely used in railway service and other heavy duty applications.

Today the field for plastic parts extends to almost every type of assembly and offers designers unusual opportunities to work out better products and to save strategic metals.

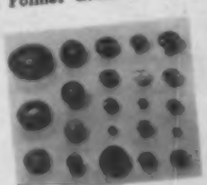
On jobs which are intricate . . . where close tolerances MUST be held . . . where threading is involved . . . or where selection of materials for the job is a factor . . . you will find the engineering service of Imperial Molded Products particularly valuable.

Our engineers will appreciate the opportunity of working with you on your problems. We make our own molds and prompt delivery can be given on products related to the war effort.

IMPERIAL MOLDED PRODUCTS CORPORATION
2927 West Harrison Street, Chicago, Illinois

← The products shown here are typical specimens of Imperial custom molding made for such organizations as Allis-Chalmers Mfg. Co., National Enameling & Stamping Co., Teletype Corp., Johnson Service Co., Western Railroad Supply Co., Thermogray Co., and Folmer Graflex Corp.

OUR STOCK MOLDS of knobs, pulls and handles can often save you time and expense. We try to maintain a large stock assortment on hand. Ask for Bulletin K-105.



Plastic Molding in

BAKELITE • PLASKON • MARALOY
DUREZ • TENITE • BEETLE • LUCITE

SPACE IS NOW OPEN IN THE 1943 PLASTICS CATALOG

Space reservations are now being made in the 1943 PLASTICS CATALOG — the only Catalog of plastics.

Reservations placed before July 1, 1942, earn the twin advantages of requested position (allotted in order of request) and a substantial saving in the cost per page. Space rates advance after July 1st.

Send your reservation in now!

A special booklet, outlining the contents of the new Catalog, has been prepared to enable agencies and advertisers to take full advantage of the medium. It is available on request. It is called "Where Is Your Initiative." Send for a *free* copy.

1943 PLASTICS CATALOG

122 East 42nd Street • New York, N. Y.

WORKING WONDERS IN WAR-TIME PLASTICS

...at ERIE RESISTOR

Dozens of different articles (which cannot be illustrated because of restrictions) are being injection-molded at Erie in large quantities for use in various branches of our armed forces. These custom-molded parts have provided a real test of molding skill. Some of the articles contain several large and small metal inserts, some require multiple dies for undercuts and intricate coring. Others are molded in clear plastics and are transformed into three-dimensional objects through the skillful use of back-painting with various colored lacquers.

No problem in war-time plastics is proving too tough to handle. Government specifications and standards, which in many instances have been more stringent than commercial practice, are being met satisfactorily. Production schedules are geared and held to desired delivery dates.

As the pioneer custom injection molder in this country, Erie has been able to build up an engineering department that is trained in both the practical and theoretical phases of injection molding. These men analyze each job from every angle before designing the molding dies. Production facilities are ample to handle large volume work. Send your next inquiry for war-time moldings to the Plastics Division of Erie Resistor.

ER *Plastics Division* ER

ERIE RESISTOR CORPORATION, ERIE, PA.

TO ASSURE VICTORY
BUY UNITED STATES WAR SAVINGS BONDS & STAMPS

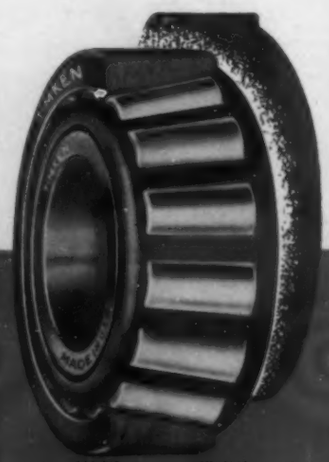
Use more Timken Bearings for quicker Victory and competitive security afterwards.

Plastics production is a comparatively new industry but it has the same old bearing problems to contend with—eliminating friction; overcoming radial, thrust and combined loads; maintaining correct alignment of moving parts.

Timken Tapered Roller Bearings are pioneering in the plastics industry as they have in so many other industries during the last 40 years—and with the same savings for their users.

If you manufacture plastics production equipment of any kind using bearings it will pay you to lay in Timken Bearings at every point of friction and hard service. Then your machines will be ready for anything — now and after victory.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO



TIMKEN
TRADE MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

GENERAL INDUSTRIES

produces molded plastics for Victory

any size—any quantity—on time

In answer to the call for total production for victory, General Industries has enlisted its facilities for the duration of the emergency. In many sectors today, plastics parts molded by General Industries are doing their part to "keep 'em flying" and "keep 'em rolling." In equipment, experience and methods, General Industries is unexcelled. Parts molded by General Industries can be depended on to meet the most rigid requirements for quality, finish and accuracy. Especially appreciated these days when every minute counts, is General Industries' sustained record for delivering "On Time."

WRITE, WIRE OR PHONE Elyria 2238

or phone office nearest you

Chicago . . . . . Phone Central 8431	New York . . . . Phone Longacre 5-4107
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Philadelphia . . . . Phone Camden 2215	Milwaukee . . . . . Phone Daly 4057

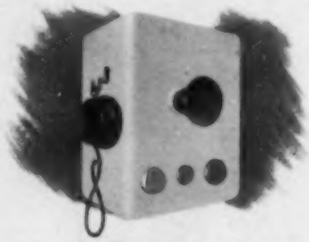
The GENERAL INDUSTRIES Co.

MOLDED PLASTICS DIVISION · ELYRIA, OHIO

THERE ARE MANY NEW AND TIMELY JOBS PLASTICS CAN DO!

Control Panels. The remarkably high dielectric strength and arc resistance of MELMAC prevents dangerous "flash-overs" on electrical control devices. Because MELMAC maintains these properties under varying conditions of temperature and humidity, it has set a new standard of efficiency for electrical parts in ignition and control assemblies.

Inter-Communication Systems. BEETLE and MELMAC provide simple, compact, efficient solutions for phone and speaker housings. Because of the molding facility of these materials, complete units can in many instances be molded in one piece, speeding sub-assemblies.



Lighting Units. Providing softer and more efficient illumination, translucent, shatter-resistant BEETLE is ideal for molded fixtures and reflectors. Electrical fixtures and wiring devices are also available in this insulating plastic.

Controls, Dials, Housings. For color identification for handles, knobs, buttons, signal control lights on instrument panels. BEETLE and MELMAC colors are a part of these durable materials. Illuminated dials and instrument housings can also be speedily produced.

Radio Parts and Housings. Electrically and thermally insulating, BEETLE and MELMAC Plastics can be widely used in radio transmission and receiving units. Durable knobs, dials, housings, can all be simply and easily molded and assembled when made of BEETLE or MELMAC.

In Shipbuilding... Light-weight, Durable Plastics Can Speed Manufacture and Simplify Assembly

To smash the shipping bottleneck calls for more speed in construction; calls for simplification of design and speed-up production of as many parts as possible. BEETLE* and MELMAC* Plastics are ready to deliver on both counts!

Sub-assemblies of BEETLE and MELMAC Plastics can be prefabricated, transported ready for installation as a complete unit aboard ship. Molded and laminated parts, housings, lighting units, control and other equipment can be mass-produced speedily, and economically. The examples shown here are but a few of many possible maritime applications where BEETLE and MELMAC may aid in speeding production or increase efficiency. Others may occur to you.

For further information on BEETLE and MELMAC Plastics, write or call:

AMERICAN CYANAMID COMPANY
Plastics Division
30 Rockefeller Plaza • New York, N. Y.
**Reg. U. S. Pat. Off.*

How to find out if you can use plastics to advantage

Complete technical data on BEETLE and MELMAC is given in our literature—available on request. If you have a specific application in mind, our engineering or service department may know the answer from previous investigation of a similar problem. In addition, our Stamford Research Laboratories are available for experimental work on new applications.

Beetle and Melmac
CYANAMID PLASTICS

MODERN PLASTICS

JUNE 1942 VOLUME 19 NUMBER 10

1

1—Training to meet all phases of modern chemical warfare, U. S. field troops quickly don gas masks as a low-flying plane disperses dense smoke. Lightweight, odorless, corrosion- and chemical-resistant parts of cellulose acetate are used in all current protective masks

New materials meet an old threat

FOR the second time in the lifetime of many of us, newspapers are carrying banner headlines proclaiming the threat—and, according to some sources—the reality of the uses of poisonous gases in the present conflict. But this time, thanks to the vigilance of our own Chemical Warfare Service, aided by the resource and cooperation of the plastics industry, the tragedy of unpreparedness may be avoided.

Since May 1937, the Chemical Warfare Service has been working assiduously with plastics material manufacturers and molders to perfect a gas-mask material that would be proof against the lethal qualities of known poison gases; and at this writing thermoplastics (cellulose acetate) are integral parts of combatant masks, training masks, officers' speaking masks and civilian masks.

The seeds of modern chemical warfare are of ancient vintage. The first use of poisonous or suffocating gases is recorded as far back as 431–404 B.C., when the Spartans saturated wood with pitch and sulphur and burned it, releasing the fumes against their enemies the Athenians. Similar uses are recorded throughout the Middle Ages. Long before poison gases became a large-scale military weapon, their possible use was in the minds of men. At The Hague Conference of 1899, several of the prominent nations of Europe and Asia pledged themselves "to abstain from the use of all projectiles, the sole object of which is the diffusion of asphyxiating or deleterious gases." At The Hague Congress of 1907, Article 23 of the Rules for War stated: "It is expressly forbidden (a) to employ poison or poisonous weapons." But it was not until April 21, 1915, when the Germans released their waves of chlorine against the English and French at the battle of Ypres and the staggering toll of casualties numbered 15,000, that chemical warfare became a full-fledged factor in modern military life.

Broadly speaking, gas is used as a war weapon to contaminate the atmosphere about the enemy's position, rendering it dangerous, or fatal, to breathe. Certain chemical agents are so toxic that a few breaths of them in high concentration will result in death by asphyxiation. Other gases may produce casualties by burns, paralysis of the hands, coughing, sneezing, tears and stomach sickness (see chart on page 42). The action of a high explosive, for example, regardless of its impact strength and striking force, is confined to a relatively limited area. And even within the radius of a bursting shell there may be fortunate combatants who will escape unharmed. Those who do are safe for the time being, for the action of the shell is spent and finished after it has exploded. Not so with poison gases. Everyone within the compass of the release of the gas is exposed equally to its effect. Unless

those who come in contact with it are adequately protected, there is no escape possible even at some distance, for gas will saturate the entire atmosphere above, below and beyond the target, and will persist for many minutes, some for many days! Eating or resting while wearing a mask is impossible, so that some method had to be developed which would make periodic respites possible, and which would enable special duty men to carry on their functions without the restrictions imposed by the wearing of a gas mask.

History of the gas mask

The first development of the gas mask was recorded in the 19th Century. Designed in 1854 by a physician, and primarily intended for industrial use, the first mask on record had the appearance of a small fencing mask of fine wire gauze which covered the face from chin to bridge of nose, leaving the eyes and forehead unprotected. The purifying apparatus consisted of two plates of wire gauze separated from each other by a small space of approximately $1/8$ in. to $1/4$ in., filled with small pieces of charcoal. The frame was made of copper with soft lead edges lined with velvet so that it would fit the cheeks tightly and enclose the mouth and nostrils. No air could enter the lungs without passing through the wire gauze and charcoal. An aperture in the outer plate was provided with a sliding screw valve, which when removed

2

PHOTOS, COURTESY CELANESE CELLULOID CORP.

3

***2**—Optically clear, high-gloss, pear-shaped lenses, injection molded of cellulose acetate, are used in the training, service and diaphragm gas masks.* **3**—*The M-8 outlet valve (upper left) used on training and service gas masks has a long shank, as it must extend beyond the apparatus below it (see opposite page). The M-10 valve (upper right) is similarly constructed, but has a short shank to fit on the side of the civilian mask (page 41). Inside view of the outlet valve seat (lower left) shows, attached in center, collar button which holds rubber flutter valve. Thin ribs permit maximum air venting. Rubber valve is in the center and the grille-like valve guard at extreme right.* **4**—*Close-up of the training gas mask with canister attached directly to the facepiece. Note the wide scope of vision made possible by the plastic lenses.* **5**—*Service gas mask joined to canister by a flexible tube. Soldier holds canister in right hand for inspection. It is carried in fabric bag hung over left shoulder*

made possible the emptying and replenishing of the charcoal chamber. These masks were worn by men who worked in large chemical plants as protection against lung-irritating gases or vapors; by men who worked in the large drains or sewers of London as protection against sewer gases and obnoxious odors; and by attendants at sickbeds where there was danger of contracting an infectious or contagious disease.

Further developments in gas masks for industrial uses followed as requirements broadened, but military aspects were considered only as an aftermath of the debacle at Ypres. Less than 48 hours after the attack, British troops received their first masks, which consisted of cotton cloth pads soaked in a solution of sodium carbonate, sodium thiosulfate and water. These materials were supplemented by cotton pads which each wearer stuffed into his mouth and nostrils before putting on the "mask." This form of protection was an emergency measure, followed shortly afterward (May 10, 1915) by the "Black Veil Respirator," so called because it was comprised of a fourfold piece of black veiling about 1 yd. long and 8 in. wide, which was tied about the face. The center portion was padded with cotton and saturated with sodium carbonate, glycerine and water, the glycerine having been added to keep the pads moist. Because of the elementary nature of the design, it was difficult to secure the mask tightly enough for adequate protection, which obviously limited the usefulness of this model.

The next refinement in gas warfare was the introduction of tear gas in shells, which made it necessary to work out some means of protection for the eyes of combatants. This need led to the development of the British Hypo Helmet. This was a flannel helmet in the form of a sack which could be put over the head with the open ends tucked inside the blouse. The cloth was dipped in sodium thiosulphate, washing soda and glycerine. Since the helmet covered the head and neck completely, some provision had to be made for vision, and a rectangular piece of cellulose nitrate (Celluloid) was inserted for this purpose. Here we have the first use of plastic materials in gas masks.

The subsequent introduction of phosgene, chloropicrin, mustard gas and toxic smoke necessitated further developments for adequate protection. These gases were so potent that it was essential to contrive a more efficient method of filtering the gases out of the inhaled air than existed up to that time. The result was the first "polyvalent" respirator of the canister type—the British "Standard Box Respirator." This new mechanism incorporated the principle of the oxygen apparatus used in mines, and it involved the use of a canister filled with highly sensitive absorbent charcoal mixed or alternating with oxidizing granules of alkaline permanganate.

It was constructed with a canister attached by a flexible tube to a facepiece or mask. The facepiece was made of rubberized fabric and fit the face snugly so that there was little or no leakage. It was secured by means of elastic bands which fit over the head. The nose was closed by means of clips covered with rubberized fabric and gauze. Breathing was achieved through a mouthpiece of rubber; the teeth closed on the rubber tabs and a rubber flange lay between the teeth and the lips. The expired air was exhaled through a rubber flutter valve in an angle tube just outside the facepiece. This arrangement provided double protection, because if the facepiece should be punctured or torn, the gas-containing air could not be inhaled so long as the nose clip and mouthpiece were in position.

There were many disadvantages inherent in the construction of this type of mask: extreme discomfort of the apparatus itself; obvious difficulty of wearing the nose clip for sustained periods and discomfort of the mouthpiece; lack of ventilation in the facepiece chamber, causing men to perspire

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6—No longer does the soldier look like a man from Mars in his gas mask. Large plastic lenses permit some view of his face and also enlarge his range of view. This close-up shows the diaphragm or speaking mask. There are 10 apertures on the valve body to permit transmission of voice without lifting the mask. A Y-tube attaches valve to canister hose. Valve guard is of M-8 valve design. 7—Thin disks of cellulose acetate (top) sealed airtight within the valve keep gases out but allow passage of sound. Below, left to right, are rubber valve, valve guard diaphragm retainer and diaphragm body (inside view)

7

most profusely; unnatural method of respiration and lack of ventilation; entrapped heat and retained moisture which condensed on eyepieces, thereby impairing vision.

The French Tissot mask resembled the British box respirator in that it consisted of a canister unit and rubber facepiece. The mouthpiece and nose clip were eliminated. The inhaled air came from the canister through two tubes which opened directly under the eyepieces. As this air swept across the eyepieces it removed the condensed moisture so that clear vision was maintained. Circulation of air in the mask also removed the dilute lachrymatory gases which might filter through. Exhaled air escaped through a simple outlet valve. The advantages of this type of mask were that its facepiece was tight and comfortable, its lenses non-dimming, and that it permitted speaking and eliminated salivary difficulties because there was no mouthpiece. The one great disadvantage was that the mask was fabricated from thin rubber, which was very flexible but not sufficiently durable to be relied upon as the sole protection of the wearer. The canister on this Tissot mask was not only different from previous developments but was actually a forerunner of the present-day types. This canister was carried against the body and connected with the facepiece by means of flexible rubber fabric tubing. The use of highly hygroscopic chemical absorptives and an easily operated one-way inlet valve made possible easier and more natural breathing.

Following the United States' entry into the war in April 1917, the gas mask adopted for American use was modeled in principle and construction after the British Standard Box Respirator, and this was the model in use at the close of World War I.

Since then research and experiment have continued unabated toward the end of improving the 1919 model Army service gas mask, as well as toward providing additional types of specialized masks such as the diaphragm mask (which permits telephone messages to be communicated while the mask is being worn), optical mask and aviation mask (for airplane pilots).

Developments since 1919

Gas mask development since World War I has been based upon certain practical requirements which control the design of the mask. These requirements may be summarized as follows:

- The mask must protect against all chemical warfare agents
- It must have low breathing resistance
- It must be light in weight
- It must be comfortable
- It must be simple in design, easy to operate and repair
- It must not interfere greatly with vision
- It must be rugged enough to withstand field conditions
- It must be reasonably easy to manufacture in quantity
- It must not deteriorate appreciably in storage for at least several years
- It must have a service life in the field of at least several months

Judged most satisfactory at present to meet these requirements, cellulose acetate was selected as the material for lenses, outlet valve guards, diaphragm and Y-tubes because it is chemically resistant, light in weight, comfortable (being a non-conductor of heat), capable of rapid production by injection molding and stable. Today cellulose acetate is being used exclusively in the service, diaphragm, training, noncombatant and all other masks being currently manufactured.

Lenses

The lenses of some of the earliest types of gas masks were clear cellulose nitrate sheet; but since this material after a few months' storage cracked and split at the slightest provocation, glass was substituted. The obvious danger of serious injury from shattering glass soon made way for the use of mica, and then for the adoption of safety glass. Its high cost, and the hazard of fine splinters of safety glass entering the eye led to further developments and the present use of non-fogging cellulose acetate. These latest eyepieces meet the rigid specifications for high light transmission, freedom from haze, absolute uniformity, optical perfection and color.

The present cellulose acetate lens, standardized for use in the service, training and diaphragm masks, is pear-shaped and curved (Fig. 2). It is injection-molded, emerging from the mold curved and optically satisfactory. A part of the specifications and tests which these lenses must meet is shown on page 43.

At the widest portion of the top, which is semi-circular with $^{47}/_{64}$-in. radii on each upper corner, it is $3^{3}/_{32}$ in. wide, the sides tapering down with an overall height of 3 in. to a bottom radius of $1^{7}/_{64}$ in. There is a $^{1}/_{8}$-in. wide land (flat surface) all around the outside specified as being .090 in. thick minus .010 in. plus nothing, and a sharp step-up from this land to a thickness of .100 in. minus .020 in. plus nothing for the center panel. The radius of the lens from side to side is constant at the center line and calls for 3 in. plus $^{1}/_{64}$ in. minus nothing.

The high optical standards for these cellulose acetate lenses make it necessary to maintain the best possible control in the various operations from first to last. The basic raw materials are subject to minute scrutiny. All the steps in the manufacturing process are monitored under laboratory control—some photoelectrically. Filtered air guards the entire process to exclude all foreign matter, and this air conditioning keeps the product sanitary despite the plant's location in a heavily industrial area. Flow tests and analyses are made regularly right up to the sealing of the drums, and just before the covers are applied a sample of powder is removed from each drum and molded into a test plaque which must be laboratory-approved and compared with the rigid specifications of the Chemical Warfare Service before shipment. Upon arrival at the molding plant,[1] these materials are carefully guarded to prevent possible contamination, and are conditioned against moisture by infrared lamps or ovens. At one producer's plant, when the materials are thoroughly dried, they are sealed in air-tight containers and stored until placed directly into the injection machine's hopper. Because of the optical specifications, the molding dies for the production of these lenses must not only be practically perfect but also maintained in this condition. In addition to a flawless, highly polished cavity finish, the mold must incorporate exceptionally accurate and identical dimensions for all cavities. When the mold is closed in the machine, it must be held absolutely tight and rigid regardless of the high pressure on the injected materials, because any tendency on the part of the mold to spring open or flash would of course destroy the dimensional accuracy of the molded parts and eliminate optical clarity. After molding, the gates are clipped while the parts are still warm, and each lens is very rigidly inspected and carefully packed so that it can be shipped undamaged to the gas mask manufacturing plants, where lenses are sealed into air-tight metal frames in the masks.

These plastic lenses permit a weight-saving of 55 percent

[1] A complete story on one method of molding these lenses will appear in a forthcoming issue of MODERN PLASTICS.

and are practically nonbreakable as compared to the glass lens formerly used. Furthermore, since cellulose acetate is a poor heat conductor, there is less tendency for these plastic lenses to fog with moisture when subjected to quick temperature changes or because of the moisture in the wearer's exhaled breath.

The success attained by these molded lenses prompted further investigation regarding the use of cellulose acetate in the noncombatant—or civilian—gas masks. Inasmuch as cost and weight were more dominant factors in this application than were accurate optical qualities, a round lens was specified (see specifications, page 43) of clear colorless cellulose acetate polished on both sides.

Five years ago, after several years of pioneering, one materials supplier[3] developed a nonfogging transparent material which was submitted to the Chemical Warfare Service for consideration. At that time, C. W. S. was experimenting with a gelatin-like unguent that had to be rubbed on lenses of civilian masks which were not equipped with a circulating air stream (as are all combatant, training and officers' masks). This was an obviously unsatisfactory expedient. Almost immediately following the procedure, the breath moisture condensed on the sticky film and blurred the vision all over again. The nonfogging cellulose acetate for eyepieces eliminated all this. Produced in wafer-thin dimensions of .015 in. thick, it is claimed that this material will not haze or blur, no matter what the provocation. These lenses are $3^1/_2$ in. in diameter, perfectly round and are required to have a thickness of .018 in. minus .004 in. plus nothing. They can be die-cut most economically from sheet stock—but in this method, too, rigid precautions must be exercised to avoid scratching or marring during the production operations.

Valves and guards

Because all combatant, training and officers' masks must be designed to allow normal breathing under such widely diversified conditions as running, scaling a wall, in arctic cold or tropical heat, and at the same time be capable of exercising their primary function of resisting war gases, enough cannot be said in praise of the all-important valves and guards. One of the first gas masks developed in 1915 incorporated an outlet valve. Such a one-way valve is very important to the efficiency of the present-day gas mask. It must function with the slightest pressure during exhalation but must positively seal upon inhalation by the wearer, and must not be affected by moisture. In sub-zero weather, if such moisture freezes, the valve must still operate successfully. The latest rubber outlet valve was of butterfly type protected by a metal guard. Now the metal guard for these valves has been replaced by cellulose acetate because it is lighter, cheaper and noncorrosive.

[3] Celanese Celluloid Corp.

8—Old style molded cellulose acetate outlet valve guards formerly used in gas masks were smaller, less efficient

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The new M 8 outlet valve which has now been universally adopted is perfectly round, incorporates more outlet area and is more sensitive and efficient than the old type. The cellulose acetate in this design forms the seat and a round rubber disk (or flutter valve) anchored to the center or collar button on the seat remains in a closed position until opened by exhalation pressure. There are three acetate parts in this assembly: the seat, collar button and valve guard.

The bottom, or seat, is perfectly round with a straight shank on the underside $^{11}/_{16}$ in. long, the main outside diameter of which is 1.062 in. minus .005 in. plus nothing with a sharp $^1/_8$-in.-wide ledge around the bottom, $^1/_{16}$ in. thick on the outside and tapering to $^1/_8$-in. thickness on the inside. The top of the seat is $1^{15}/_{16}$ in. outside diameter, and there are inside threads for the assembly of the guard. To allow for the maximum air space and support for the collar-button boss, there are six slender spokes. The seat proper for the flutter disk is slightly beveled and approximately $^3/_{16}$ in. wide.

The collar button, molded separately, is acetoned into the seat boss and is $^{11}/_{32}$ in. long incorporating 3 diameters. The top is .375 in. in diameter and .050 in. long; the shank is .235 in. in diameter and .155 in. long; and the bottom is .126 in. in diameter and .139 in. long. Close tolerances must be maintained during the assembly of these collar buttons in the seat bosses, due to the fact that the height of the button determines the position of the rubber valve flange or lip.

The guard, which is assembled to the seat by threads, performs no definite function other than to protect the flutter valve. However, the fit of the threads is most important because of the standardization of the units and consequent interchangeability. The perfectly balanced pattern of the grille on the combination valve and guard actually forms a scientifically balanced air vent. The plastic struts on the guard give precisely the necessary strength—no more, no less. A silken strand's thickness more might make exhalation difficult! This grille protects the flutter valve that fits over the valve seat in the lower section. Without the cover grille, this lightweight flutter valve might be accidentally lifted and expose the wearer. Both parts are injection molded and completely threaded.

The fact that there are a number of injection molders who will furnish these parts, and that parts are standardized for use on both service and training masks, presents a problem in manufacture and interchangeability of parts. Not only must the materials be maintained in the same formulations, flow and shrinkage characteristics, but it is necessary that the various producers mold the parts with similar temperatures, material pressures, cycles and die temperatures. As a continuous dimensional check on these parts for proper fit, each molder will be furnished with "go" and "no go" gages.

The M 10 outlet valve for use on the noncombat type of gas mask is identical to the M 8 except that the shank on the underside of the seat is almost $^1/_2$ in. shorter in length. (Some of the specifications and tests these valves must meet are listed on page 110.)

Diaphragm mask

The diaphragm mask is especially designed to meet the requirements of administrative or other personnel of the Army

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***9**—Round lenses, die-cut from clear non-fogging cellulose acetate sheet stock and polished on both sides, used for civilian masks.* ***10**—Civilian or non-combatant gas masks have the canister attached to the facepiece, and the M-10 outlet valve on left side of the facepiece*

who require a form of protection that will not interfere with commands, duties, etc. The mask is identical with the service mask except for the facepiece, which includes a diaphragm to facilitate the transmission of the sound of the voice. The angle tube, valve and guard combination has been perfected so that orders can be given without raising the mask and risking exposure. This gives complete protection and yet permits passage of sound. The cellulose acetate diaphragm facepiece is designed to be molded in five parts: body, valve seat, collar button, valve guard and diaphragm retainer.

The body is elliptical in shape and incorporates the same round design as the M 8 valve case in the bottom. It is approximately $4\frac{1}{8}$ in. high and the top circular portion is almost 3 in. in diameter. Due to the necessity of coring the M 8 case design, the valve seat is molded separately and acetoned in the assembly. The collar button is also assembled in the same manner as in the M 8 valve previously described. The standard M 8 valve guard is assembled to the valve housing by means of the threads. The diaphragm retainer is a perfectly round part $2\frac{9}{16}$ in. in diameter, including the outside threads. The outside threaded portion is similar to a flat cup $\frac{5}{16}$ in. overall and the inside $\frac{1}{4}$ in. deep. There are two rectangular-shaped lips $\frac{1}{16}$ in. high and $\frac{1}{8}$ in. long, diametrically opposite on the inside for convenience in assembly with a spanner type wrench. In the bottom half of this retainer is an oblong, shaft-like opening $\frac{15}{32}$ in. high, at the top of which is a $\frac{1}{32}$-in. bead running half way around the opening and another similar bead $\frac{9}{16}$ in. long at the bottom. To make the sound openings in the diaphragm body airtight, round disks of cellulose acetate sheet stock .001 in. thick are fitted into the body. The diaphragm, cemented around the edges, is inserted under the perforations and a rubber gasket is used underneath the retainer to seal the assembly when the retainer is screwed into place. The whole acetate diaphragm assembly is approximately 59 percent lighter than the metal it replaces, in addition to being more efficient because of the use of the new M 8 valve design. Some of the specifications and tests which this diaphragm must stand are shown on page 114.

In the diaphragm mask it is also necessary to use a Y-tube which is shaped almost like the letter Y itself. Formerly a die-cast part or one made from other noncorrosive metal, this part was not only heavy but expensive. Although the Y-tube was originally designed to be made in cellulose acetate in three parts, there is now an alternate design for two-piece production. The original acetate design comprised a round tubular shaped T, onto the arms of which were acetoned two tubular elbows, parallel with each other. The two-piece Y-tube incorporates an oblong shaped opening at the bottom $1\frac{1}{16}$ in. long by $\frac{9}{16}$ in. high inside and it is $1\frac{7}{16}$ in. along the center line of this part of the piece to the center line of the two round tubular legs, which are $\frac{9}{16}$-in. inside diameter. These legs are parallel $\frac{3}{4}$ in. long and 45 deg. to the main or oblong part. In this design the Y-tubes are molded in two halves, the parting line following the 45-deg. angle. Small $\frac{1}{32}$-in. radius beads are incorporated on the outside of the three extreme ends to render them more secure in the assembled mask. Inasmuch as these two halves must be acetoned together and airtight, a tongue and groove design is proposed for a better joint. (Some of the specifications for these parts in cellulose acetate are shown on page 118.)

The adoption of cellulose acetate for these various gas-mask parts represents a distinct advance in design and performance. In the service mask it has resulted in a weight saving of 70 percent as compared to the glass and metal parts previously used, and in the diaphragm mask 58 percent on the same basis. While proof against corrosion, these parts must be carefully molded and controlled so that they will not warp or become distorted in service. Considerable difficulty was

Chemical Warfare Agents

Reference and Training Chart

Name	*Class*	*Odor*	*Physiological Effect*	*First Aid*	*Color and State Loaded*	*Released*
MUSTARD Dichlorodiethylsulfide	Gas	Garlic Horseradish Mustard	Burns skin or membrane	Remove clothing. Wash affected parts of body with soapy water. Do not bandage	Heavy dark, oily liquid	Liquid slowly evaporates
LEWISITE Chlorvinyldichlorarsine	Gas	Geraniums	Irritates nasal passages. Later skin burns, poison	Apply 2 to 5% solution hydrogen peroxide to skin. Wash with soap and water. Wash eyes with 1/2 of 1% hydrogen peroxide	Heavy dark, oily liquid	Liquid slowly evaporates
ETHYLDICHLORARSINE	Gas	Biting Stinging	Causes blisters, sores	Same as for Lewisite	Clear oily liquid	Evaporates at medium rate
CHLORPICRIN Nitrochloroform	Gas	Fly paper Anise	Causes severe coughing, crying, lung edema	Wash eyes, keep quiet and warm. Do not rub eyes	Yellow oily liquid	Evaporates like water
DIPHOSGENE Trichlormethyl chloroformate	Gas	Musty hay Green corn Ensilage	Causes coughing, breathing hurts, eyes water, toxic	Keep quiet and warm. Give coffee as a stimulant	Colorless liquid	Evaporates like water
PHOSGENE Carbonyl chloride	Gas	Musty hay Green corn Ensilage	Irritates lungs	Keep quiet and warm. Give coffee as a stimulant	Colorless liquid	Colorless gas
CHLORACETOPHENONE	Gas	Apple blossoms	Makes eyes smart, shut tightly, tears flow. Temporary	Wash eyes with water or boric acid. Do not rub or bandage. Skin, $NaCO_2$ solution	Brown crystalline powder	Cloud of small, solid particles
BROMBENZYLCYANIDE	Gas	Sour fruit	Eyes smart, shut, tears flow. Effect lasts some time	Wash eyes with boric acid. Do not bandage	Dark brown oily liquid	Slowly evaporates
ADAMSITE Diphenylamine chlorarsine	Gas	Coal smoke	Causes sneezing, sick, depressed feeling	Remove to pure air and keep warm and quiet. Breathe small amounts of chlorine	Yellow green granular solid	Yellow smoke
H C MIXTURE	Smoke	Sharp-acrid	Harmless	Produces no effect requiring treatment	White to grey solid	Grey smoke
SULPHUR TRIOXIDE in chlorsulfonic acid	Smoke	Burning matches	Liquid burns skin if allowed to remain	Wash with soda solution	Clear to brown liquid	Dense white smoke
TITANIUM TETRACHLORIDE	Smoke	Acrid	Harmless	Produces no effect requiring treatment	Yellowish liquid	White smoke
DIPHENYLCHLORARSINE	Smoke	Shoe polish	Causes sneezing, sick, depressed feeling	Remove to pure air, keep quiet. Sniff chlorine from bleaching powder bottle	White crystalline solid	Vapor or fine smoke
WHITE PHOSPHORUS	Smoke	Burning matches	Burning pieces adhere to skin, clothing	Plunge in mud to smother	Pale yellow solid	Burns to white smoke in air
THERMIT (Thermite)	Incendiary	Odorless	5000 deg. heat ignites materials	Treat for burn	Metallic powder	...
CHLORINE	Gas	Highly pungent	Intense immediate choking	Remove from gassed area. Keep quiet and warm. Coffee as stimulant	Yellow liquid	Yellow-green gas

previously experienced by the fogging of the glass lens because glass is a good conductor of heat, but since the acetate is a poor conductor, its fogging tendency is not nearly so acute. All of these parts are molded by the injection method and consequently can be produced very rapidly. They will not tarnish and no painting or lacquering for protection is required. They are more economical than the parts replaced, and save considerable amounts of critical metals (brass and aluminum) previously required.

More than that, they represent thoughtful and unflagging experimentation on the part of men who were determined to find the solution to seemingly insuperable problems. Men like Col. Barker, Col. Kuhn and Dr. Katz of the Chemical Warfare Service; men like Harry Husted, whose vision, combined with a great fund of knowledge of thermoplastics, molds, machines and techniques, is directly responsible for much of the progress that has been recorded to date; and a host of anonymous chemists, technicians, laboratory workers, all of whom labored against odds to achieve a victory over one of the greatest hazards of war. Above all, they are a tribute to the Chemical Warfare Service, which was prepared for a grim emergency even before the emergency became a reality.

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SPECIFICATIONS

NOTE: *The following excerpts of specifications for the various plastics gas-mask parts are published here by special permission of the Chemical Warfare Service, and may not be reproduced either wholly or in part except when authorized by the Chief of Chemical Warfare Service. The sections which follow indicate the rigid tests and requirements both plastics and parts must meet in order to be applicable for gas masks.*—ED.

CWS SPECIFICATION EXCERPT, No. 197-51-132
LENS, CYLINDRICAL, MOLDED

C-1. *Material.* The lens shall be made of a suitable methyl methacrylate or cellulose acetate molding composition that will produce a lens which meets the requirements of this specification. Only virgin material shall be used in molding lenses made in accordance with this specification.

DETAIL REQUIREMENTS

E-1. *Manufacture.* The lens shall be molded to conform to the design, dimensions and notations delineated on C.W.S. Drawing No. E5-2-263. If cellulose acetate is used in molding lenses under this specification no dye shall be added. The lenses shall be buffed carefully, but the buffing shall be done not sooner than 24 hours after molding.

E-2. *Optical characteristics.*

E-2a. *Zoning.* For the purpose of specifying the optical characteristics of the lens, the face thereof shall be considered as being divided into two zones as follows:

E-2a(1). *Zone A.* Zone A shall be that portion of the face of the lens which is circumscribed by a circle 1 1/2 inches in diameter the center of which is located on the vertical center line 1/2 inch below the horizontal major axis of the lens. (See C.W.S. Drawing No. E5-2-263.)

E-2a(2). *Zone B.* Zone B shall be that portion of the face of the lens lying outside Zone A and circumscribed by a line 1/4 inch inside the periphery of the lens.

E-2b. *Optical.* The optical characteristics of the respective zones of the lens shall be as follows:

E-2b(1). *Zone A.*

E-2b(1)(a). *Transmission of light.* The transmission of light through the lens shall not be less than 80 percent.

E-2b(1)(b). *Prismatic effect.* The prismatic effect of the lens shall not be more than 3/8 of a prism diopter.

E-2b(1)(c). *Refractive power.* The refractive power of the lens shall not be positive by more than 1/8 diopter and shall not be negative by more than 1/4 diopter.

E-2b(1)(d). *Distortion of vision.* The lens shall be free from striae, waves, flaws, discolored areas, cracks, scratches, bubbles, dirt spots or other imperfections that materially distort or impair vision through the lens.

E-2b(2). *Zone B.*

E-2b(2)(a). *Transmission of light.* Not applicable.

E-2b(2)(b). *Prismatic effect.* Not applicable.

E-2b(2)(c). *Refractive power.* Not applicable.

E-2b(2)(d). *Distortion of vision.* The lens shall be essentially free from striae, waves, cracks, scratches, bubbles or any other major imperfections.

E-3. *Impact resistance.* The lens shall withstand the impact of a hardened steel ball 1/8 inch in diameter dropped from a height of 30 inches without showing any evidence of fracturing or cracking.

METHODS OF SAMPLING, INSPECTION AND TESTS

F-1. The material and work shall be subject at all times to inspection at the place of manufacture and every facility shall be afforded authorized Government inspectors for the prosecution of their work.

F-2. *Lot size.* A lot shall consist of twenty-five thousand (25,000) lenses unless otherwise specified in the invitation for bids.

F-3. *Samples for inspection and test.*

F-3a. *Dimensions.* All lenses in a lot shall be inspected for compliance with this specification as to dimensions.

F-3b. *Optical characteristics.*

F-3b(1) *Transmission of light.* One-half of one percent but never less than twenty (20) lenses from any lot shall be tested for transmission of light. (See Section H, Paragraph H-1.)

F-3b(2). *Prismatic effect.* One-half of one percent but never less than twenty (20) lenses from any lot shall be tested for prismatic effect.

F-3b(3). *Distortion of vision.* All lenses in a lot shall be inspected for imperfections that distort or impair vision.

F-3c. *Impact resistance.* One percent, but not less than twenty (20) nor more than fifty (50) of the lenses from each lot shall be given the impact resistance test.

F-4. *Inspection and test.*

F-4a. *Dimensions.*

F-4a(1). *Thickness.* The thickness of the lenses shall be measured by means of suitable gages or measuring devices.

F-4a(2). *Periphery and contour.* Compliance with dimensions pertaining to the periphery and the face contour of the lens shall be determined by means of suitable gages, templates, or measuring instruments.

F-4b. *Optical characteristics.*

F-4b(1). *Transmission of light.* The transmission of light through the lens shall be determined by means of a photometer, which is accurate within ± 2.0 percent.

F-4b(2). *Prismatic effect and refractive power.* The lens shall be tested for prismatic effect and refractive power by means of suitable lens measuring instruments such as a telescope or lensometer.

F-4b(3). *Distortion of vision.* The lens shall be inspected for striae, waves, or surface irregularities by visual observation, through the lens, of a chart consisting of vertical and horizontal lines.

F-4c. *Impact resistance.* Lens selected for the impact resistance test shall be subjected to the impact of a hardened steel ball, 1/8 inch in diameter dropped from a height of 30 inches. The lens shall be mounted on a cylindrically formed wood surface recessed under the lens except for the supporting margin 1/4 inch wide. The impact shall be applied perpendicular to the tangent at the center of the zone A circle. The failure of one lens in ten (10) will be permitted.

CWS SPECIFICATION EXCERPT, No. 197-51-123
SHEET, PLASTIC, 1/64-INCH, CELLULOSE ACETATE BASE

C-1. The material shall be transparent and free from defects which render the finished product unfit for use as gas mask eyepieces.

DETAIL REQUIREMENTS

E-1. The finished material shall be suitable for goggle lenses, inspection windows, gaskets and for other similar purposes.

E-2. *Form.* The finished material shall be furnished either in sheets or in continuous rolls, as specified in the invitation for bids.

E-2a. *Size.*

E-2a(1). *Sheets.* The sheets shall be 20 ± 1/16 inches wide by 50 ± 1/16 inches long.

E-2a(2). *Continuous rolls.* Continuous rolls shall be at least 50 ± 1/2 inches wide and 225 ± 25 feet in length.

E-2b. *Thickness.* The sheet shall have a maximum thickness of 0.018 inch and a minimum thickness of 0.014 inch.

E-3. *Flammability.* The rate of burning of a 1 × 6 inch strip of the finished material, if combustible, shall not exceed six inches in two minutes under the test conditions specified in Section F, Paragraph F-5 of this specification.

E-4. *Light transmission.* The finished sheet shall show a light transmission of not less than 80 percent.

E-5. *Flexibility.* The finished sheet shall be sufficiently flexible to withstand the flexibility test specified in Section F, Paragraph F-7 of this specification, without evidence of crazing, cracking or rupturing.

E-6. *Optical defects.* The contractor shall furnish a statement that the finished sheets or rolls are free from visible defects to the extent that no two imperfections shall be allowed within 6 inches of each other, and in the case of sheets, not more than 8 defects shall be allowed to a sheet. Visible defects shall be interpreted as blisters, pits, bubbles, scratches, cracks, crazing, striae or other imperfections which would impair the usefulness of the material for making gas mask eyepieces.

E-7. *Moisture absorption.* The finished material shall not absorb more than 6.0 percent of moisture when immersed in distilled water for 24 hours at 75 ± 5 deg. F.

(*Please turn to page 108*)

Framing the shower door

PROVIDING adequate housing for our "soldiers of production" as well as for their brothers in arms has become one of the nation's chief domestic undertakings. The problems of choosing sites in proximity to war plants, planning for speedy, economical construction and getting labor for the job are urgent. But of equal importance has been the need for replacing materials going into war production.

Plastics have moved very slowly into the building field; and the recent use of thermoplastics in quantity has been largely accelerated by improved molding and extrusion techniques which made use of new, suitable plastic compounds. The latest application is a plastic shower door frame which makes use of several ingenious extruded forms for its construction. Called the "American Maid," the glass shower door is custom built to fit either a separate shower stall or the enclosure for a built-in, recessed bath tub, as the door can be made to roll back or swing in and out (Fig. 1).

PHOTO, COURTESY TENNESSEE EASTMAN CORP.

1

Each door is supported along its entire length by a continuous piano hinge of metal, and is said to be proof against sagging or warping. The glass section of the door is pressure-set in non-deteriorating rubber which protects against breakage and insures a tight fit within the plastic framing-section. The method of installation is shown in the diagram below (Fig. 3): H—Profile view of the glass door; I—Rubber support; J—Extruded plastic framing-section; K—Metal piano hinge; L—Strike-jamb or door stop.

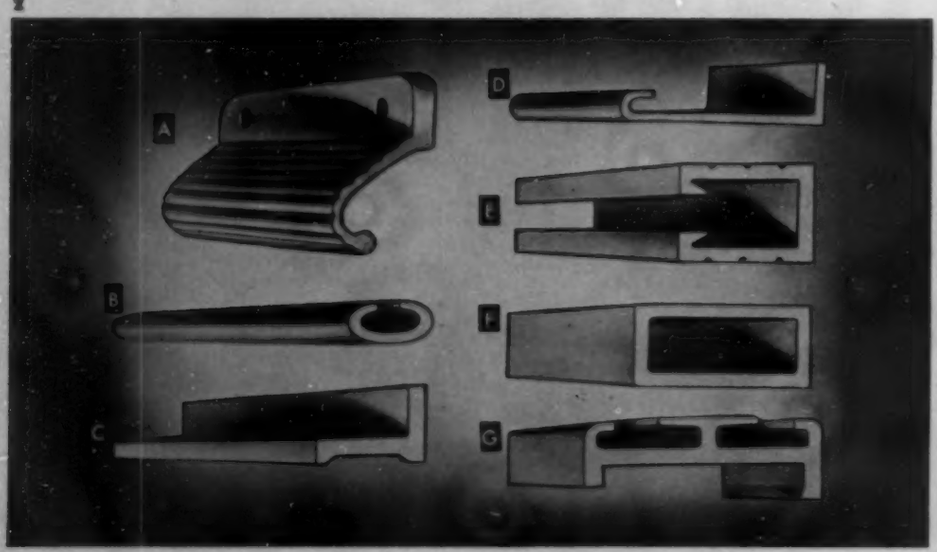
Seven different plastic sections (including those mentioned above) have been extruded for use with the shower door. Figure 2 illustrates these cross sections. The offset handles (A) have a fluted design which matches the channeled frame support. The rounded damstrip (B) serves as a threshold where the tiled sill of the shower does not slope sufficiently. The strike-jamb against which the handles slide and the door stops is outlined in (C). A special section with a wide lip (D) protects the bathroom floor when the shower door is opened. The fluted framing section which holds the glass and rubber support (E) is shown horizontally. The square hollow tubing (F) is employed for reinforcing corner members on doors and sliding parts of tub enclosures.

The doors are installed by means of the sliding guide track (G). Enclosures are set on the rim of a recessed bath tub, one ledge shorter than the other as shown, to permit drainage.

By using cellulose acetate butyrate the manufacturer has provided a material that is easy to clean; won't fade, tarnish or corrode; can be nailed, drilled, easily assembled; is colorful and decorative; and needs no polishing to retain its luster.

Credits—Material: Tenite II. Extruded by American Shower Door Co., Inc.

2



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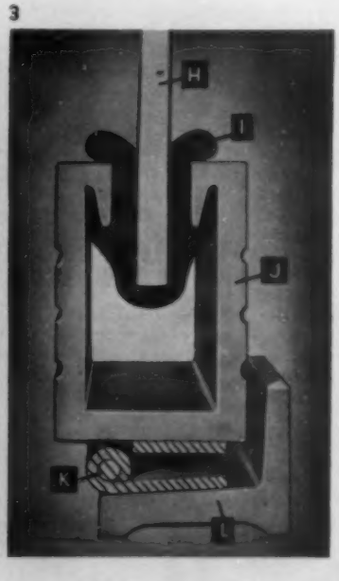


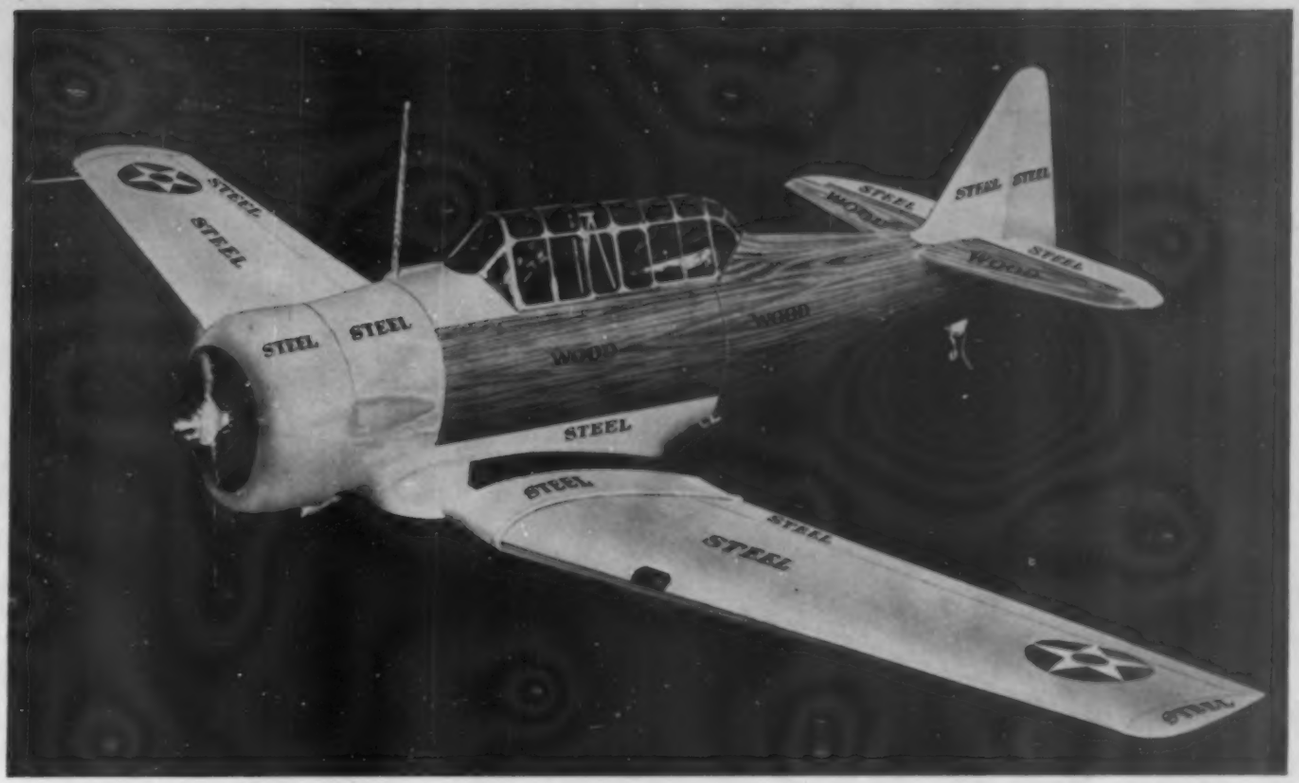

STEEL
STEEL
STEEL

PHOTO BY U. S. ARMY SIGNAL CORPS

1

1—Ammunition for artillery pieces like this 60-mm. trench mortar must meet time-proven standards. Plastics used to replace metals in mortar shells must have good impact strength, low water absorption and pass strict temperature tests

Artillery ammunition—a challenge!

by CAPT. F. A. MARSHALL*

Successful molding of the plastic mortar shell fuze and 37-mm. dummy fuze leads the way to similar plastics developments for these vital needs

AT Montereau, on Feb. 17, 1814, Napoleon Bonaparte boasted: "The bullet that will kill me is not yet cast." But the ammunition that devastated his army at Waterloo was then in the making—and the shells, bombs and bullets that will wipe out today's would-be Napoleons are on the production line, have already done service on the world battlefront.

In the vast supply program ahead, however, the research laboratories, scientists, engineers and all industry have just begun to fight. The production problem, like any other active military situation, is being estimated in the light of conditions changing daily but with ultimate objectives clearly in mind, plans for solution of difficulties formulated and in force. Industry and Government have attacked this problem together and cooperation has brought forth amazing achievements.

The plastics industry has a tremendous share in the entire program. Its remarkable contributions to aircraft, marine and other types of war matériel have long since been spotlighted. But in artillery ammunition, plastics have played a secondary rôle. This essential field—in ammunition components, bombs and all phases of pyrotechnics—offers a real challenge to the ingenuity, perseverance and enterprise of a wide-awake, war-production-minded plastics world.

Starting back in the summer of 1941, the Artillery Ammunition Branch of the Ordnance Department has been continually called upon to substitute plastics for the various metals now standard for ammunition components. To the average molder who glances at the many fuzes and other components that assemble into a complete round of ammunition, it seems that plastics are a "natural" for certain parts. These parts are generally those that can be molded easily either by straight compression or by transfer molding, and on the surface there appears to be no reason why plastics cannot be substituted for the metals now used. However, there are reasons—and many very good reasons—why these parts cannot be made from plastics now available commercially.

The paramount reasons are that these parts made from plastics would not withstand the tremendous stresses obtained when fired in high velocity weapons; and that many plastics cannot withstand the temperature and acceptance tests established for these parts, which tests are of vital importance to insure safety and proper functioning of the assembled components.

Generally speaking, some of these parts could be made from plastics if consideration is given to redesigns and increased dimension tolerances. This, however, involves considerable study and development work; and at the present, when production and procurement are of utmost importance, time for such investigation and development is difficult to find. Every effort is being made to substitute plastics wherever possible in order to conserve and replace critical metals. Many parts have been selected and development work initiated so that more knowledge and data can be acquired for determining the feasibility of substituting plastics for metals.

* Assistant, Office of the Chief of Ordnance, U. S. Army.

Much of this work has terminated in success, but in the majority of cases so far the results have been discouraging.

First let us consider some of the requirements for plastics in artillery ammunition:

1. The plastic compound must be of a thermosetting type.
2. High impact strengths are of utmost importance. Medium impact materials may serve for a few components where velocities are low, as in the mortar shell fuze.
3. The dimensional tolerances called for on the drawings must be assured for proper functioning and interchangeability.
4. The molded material must be physically stable under rapid temperature fluctuations in the range of −40 deg. F. and +170 deg. F., or when alternately wetted and dried, or when maintained continuously at a temperature within the range specified above.
5. The finished molded piece must have smooth surfaces, especially those surfaces where contact is made with moving parts.
6. Finished pieces must be free from warpage, checks or cracks, blisters or other defects which will affect their serviceability.
7. Pieces must withstand all required tests standard for the material for which substitution is being made.
8. The assembled component with the plastic substitutes must meet all tests, including proving ground tests established for the component.
9. Plastic materials must possess low bulk factors.

Now consider the parts plastics are to replace:

Most of the parts judged to be appropriate for duplication in plastics are made of hard brass and of aluminum. This definitely sets up a tensile strength requirement for this service, on the part of plastics, of approximately 40,000 lb. per sq. in., and also an appreciable measure of ductility to prevent shattering at the instant of firing. Most commercial plastics, as the molders are undoubtedly aware, stop considerably short of 40,000 lb. per sq. in. tensile. Undoubtedly, experiments are being conducted to obtain plastics possessing high tensile strengths and impact values. So far, the higher-impact plastics[1] do not lend themselves easily to molding, and this alone counters the fact that these same parts must be obtained at production rates. If plastics can be formulated to obtain tensile strengths on the order of 40,000 lb., with elongations around 5 percent at the yield point, with plasticizers to give sufficient ductility to prevent shattering, there is every possibility that many parts now made from brass and aluminum can be made from plastics.

In the past, suppliers of plastic materials have never been called upon to furnish material requiring extremely high impact strengths. The powders required were used mainly for novelties, utensils and electrical parts that seldom were subjected to high stresses. For electrical insulators, dielectric strength tests are important; and tensile, compressive and flexural strengths may be of relatively low values. For novelties and utensils, strength is not of great importance, and breakage or fracture causes no great harm. Where strength requirements are necessary, laminated products are employed, provided that the part can be molded easily by direct compression. Complicated or intricate shapes cannot in the majority of cases be molded from laminated products. Thus, when fuze parts are considered, the odd shapes of various components eliminate the possibility of using high-impact laminated products. Where parts must be fabricated in arge quantities, the bulk factor of the plastic material plays an important rôle, and unless this factor can be kept reasonably low, mass production molding is quite impossible.

In order that we may understand more clearly what has been accomplished to date in the use of plastics for components of artillery ammunition, let us consider a few outstanding projects and follow them through the various stages of development. (*Please turn to page 104*)

[1] On page 70 of this issue there is a technical story on the development of a new high-impact material. This article, of course, has no connection with Capt. Marshall's paper.

2—A 37-mm molded plastic dummy fuze (left) and an assembled mortar shell fuze (right.) **3**—*The latter's 3 plastic parts, left to right: compression-molded fuze well cup and nose and transfer-molded body*

3

Molded sign alphabet

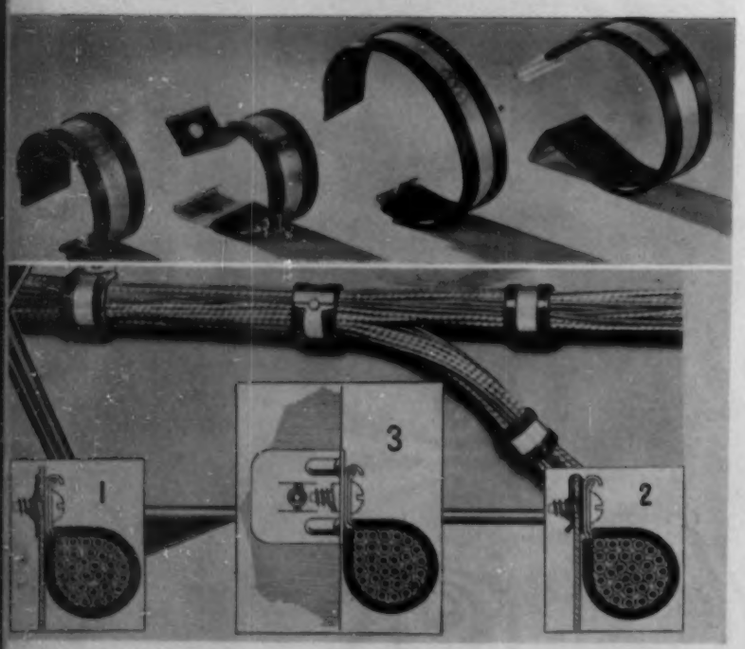
When its metal supply was curtailed, Wagner Sign Service, Inc., switched its two most popular sizes of profile sign letters and the channel molding (for holding opal glass in the background) from light metal to cellulose acetate. The result—a product that combined the multiple advantages of improved appearance, increased use, greater facility of manipulation and withal, decreased cost, and an aggregate saving of a half million pounds of aluminum a year.

The weight saving—57 percent—is an important factor, making possible speedy and easy handling when changes are necessary. In metal, the 4-in. letter weighed $4\frac{1}{2}$ oz.; in cellulose acetate, not quite 1 oz. In metal, the 10-in. size weighed 1 lb.; in cellulose acetate, it weighs 4 oz., and despite the weight disparity, there has been no decrease in strength.

Ease of installation is achieved by a slotted arrangement which makes it possible to hang the letters outdoors, over the cellulose acetate channel against opal glass. Indoors they may be used upright or suspended on a narrow strip which is slotted to hold small wire clips. A twist of the wrist is all that is necessary to install one of these letters.

The letters are translucent, and the brilliant high-lighted colors are dramatic and effective for marquees, window signs.

Credits—Material: Lumarith. Molded by American Molded Products Co.



Aircraft wiring clamps

There's no time to be lost in any phase of aircraft manufacturing today, and in order to expedite assembly of $\frac{1}{4}$ to $1\frac{1}{2}$-in. wire "bundles" two new series of harness speed clamps in 10 sizes have been developed. These clamps are covered with extruded vinyl channels, which provide a cushion to resist abrasion. The extruded vinyl is reported to withstand rubbing and natural abrasion from aircraft wiring more than 10 times longer than materials previously used. It is tough, has high tensile strength and will remain flexible in temperatures ranging from −30 to + 70 deg. F.

One series is used at intermittent locations where groups of wires branch off from the main harness. The second series functions as supporting clamps for quick attachment to the main structure. They are designed so that they may be quickly snapped around the harness at the point of make-up so that no taping or "boggles" are required, and then serve as the mounting means for attaching the harness itself to the structure. Lower photo at left shows 3 methods of speed nut attachment: (1) with standard flat type, (2) with "U" type snapped over edge of flange, (3) with bracket type for attachment to structure at various angles.

Credits—Material: Vinylite, extruded by Carter Products Corp. Manufacturer: Tinnerman Products, Inc.

Dress sword handles

Versatile plastic materials fill the ranks, and here they step in where baby shark skin formerly functioned! For generations, the Navy dress sword was made with a grip of Norwegian baby shark skin, which was bleached white, and stretched over a wooden core. This skin had a pebble-grained surface, and came from sharks indigenous only to Scandinavian waters. With the advent of World War II, the source of supply of these skins was cut off, and a new material had to be found.

One manufacturer solved the problem by using injection-molded ivory-hued cellulose acetate butyrate. The construction of the die for this handle presented a special problem because the shape of the handle is very distinctive, and the core is almost square. Also in order to retain the mottled effect, there could be no buffing or finishing of the seam after molding, which required the clamp to be extremely tight.

Before the grip is assembled on the sword, it is wrapped barber-pole fashion with a gold "cord." The cord is actually brass wire mangled through a roller into an elliptical shape during which process tiny stars are pressed into its surface, after which the wire is gold-plated and wound into place on the plastic grip. The handle is easily cleaned.

Credits—Material: Tenite II. Molded by Ohio Plastics Co. Manufacturer: Lilley-Ames Corp.

PRODUCT DEVELOPMENT

Blackout reflector disks

With regular blackouts an imminent possibility, new glare-free, lightweight, methyl methacrylate reflector disks will help to prevent stumbling in darkened areas and accidents on blackened highways. Operating very much like the luminous plastic house numerals and highway reflector buttons, the reflector disks employ the principle that the amount of reflection given by any reflector of the lens type depends on the power of the lens and the focus of the reflecting surface. In this reflector disk a series of small lenses is employed, which reduces the distance of the focus and results in a more shallow finished piece. Shallow reflection permits a wider angle of vision and helps to maintain brightness in daylight hours. The reflecting surface consists of aluminum foil backed by a board that has been saturated in paraffin wax and finished off at the back with a special varnished paper. The outside surface is smooth because the tiny parabolas for control and magnification of light are molded inside the disk. The rim, which secures the reflecting surface in correct focus with the lenses, is also molded within the disk.

The disks each measure $^3/_4$ in. in diameter, and are molded 40 per sprue. They are available in four colors.

Credits—Material: Lucite. Molder: Pyro Plastics Co. Varnished paper: Irvington Varnish Co. Mfr: Lumelite Corp.

Rolling out production

Resinoid truck wheels are used for industrial truck and caster purposes

SOME 4000 years ago, man chanced upon the principle of the wheel, and as it developed, so did an expanding civilization. Today, in a wartorn, production-fevered world, the wheel has attained a new pinnacle of importance. Across the continents of the world, wheels are rolling munitions and food supplies to our offensive armies and navies; wheels are moving essential raw materials, semi-finished and completed units out of the factories and mines, onto assembly lines, to warehouses, docks, aboard ships and into the field of battle; wheels are carrying loads of materials across acres of industrial plant floors, from department to department.

In this speed-up program, plastic wheels are sharing the load, and participating in the general effort to "keep 'em rolling." Resin-bonded wheels of various types for heavy industrial uses, which embody the strength of steel and the rolling facility of rubber, have been used almost exclusively in many industries since their introduction, and today, virtually every type of war production plant is using resinoid wheels for materials-handling. They are performing an outstanding job under abnormal conditions, carrying enormous loads, and proving themselves over and over again as a ranking contribution to the success of smoothly and speedily operating production lines.

One new resinoid wheel, available in several sizes for industrial truck and caster uses, is a plastic unit composed of two component parts, the resilient core, and the laminated tread, molded into a unit that is described as practically indestructible.

The core stock is a combination of synthetic resins and various fillers, selected for the specific purpose which they must fulfil. In manufacture, the filler is impregnated with synthetic resin, and then pre-formed to the desired shape in a pressure mold. The core stock is compounded for resiliency, and shock-absorbing qualities to make the wheel highly resistant to impact. The inherent quality of the material itself simulates the cushion-type wheels without sacrificing rolling efficiency.

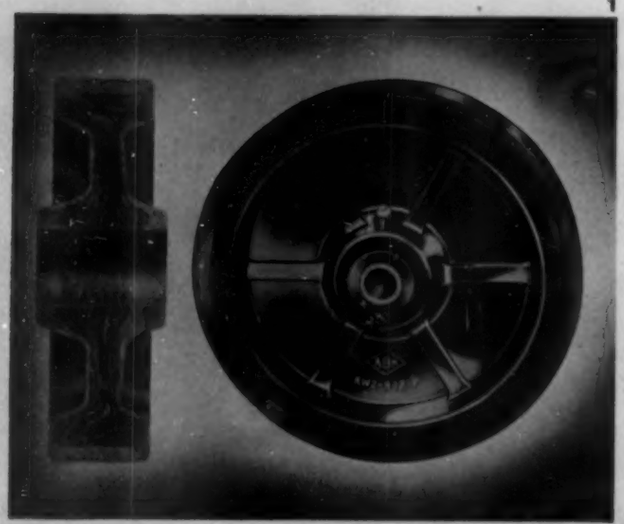
The tread stock which consists of high quality duck is then impregnated with thermosetting resins, and cut to the desired width necessary to fit the wheels for which it is intended. Finally, it is wound in a continuous strip to the required thickness necessary for the tread.

This laminated tread material is said to be extraordinarily resistant to wear and impact, and has demonstrated its durability in use as stern tube bearings in ships,* as well as in bearings used in steel rolling mills. The nature of the laminated structure reduces chipping of the tread to a minimum, and reduces floor maintenance costs considerably.

The laminated tread and (*Please turn to page 100*)

* Marine bearings, MODERN PLASTICS, April 1942, p. 33.

1



2

***1**—A cross section of the core stock before it is combined with laminated tread to achieve finished resinoid truck wheel at right.* ***2**—The finished wheel in two sizes doing service on an industrial dolly bearing a capacity load on its way to the next operation*

PHOTO, COURTESY IVORYCRAFT CO., INC.

1—*This keen-eyed youngster displays his cast phenolic resin identification tag indelibly stamped with his name, school registration number and home city—information which may tell a vital story for him, as for 1,600,000 other New York school children in case of emergency*

Signs for the duration—and after

HEARD above the sounds of conflicting ideologies in this war is the realistic battle cry on the production front to CONSERVE METALS! And throughout America plastic materials are doing just that, not only as alternates but as replacements, where they are functioning with increased efficiency and often with a higher degree of performance satisfaction than the material replaced.

Thermoplastics

In New York City recently, 1,600,000 school children were presented with small, round, ivory-hued plastic disks. These are identification tags which, in the event of future evacuation of children from coastal cities, may be the means of guarding against possible tragic confusion. Fabricated of cast phenolic resin, the disks are machined from rod stock measuring $1^{3}/_{16}$ in. in diameter, and cut in thicknesses of $^{56}/_{1000}$ of an inch. Inscribed in blue script on each disk is the child's name, date of birth, school registration number and home city—data which will make possible immediate and accurate identification in case of emergency. The inscription is made on the disk by a pantograph machine which traces the name from a written card directly onto the cast phenolic disk. A small hole is drilled top and bottom so that it may be worn suspended about the child's neck like a necklace, or laced around his wrist like a bracelet (Fig.1). Cast phenolic resin, well suited for an application of this nature, is hard and durable, nonflammable, virtually unbreakable, and will not irritate or in any way affect sensitive skin with which it must be in constant contact. The color is permanent and stable, and the engraving once applied will remain clear and legible almost indefinitely.

It isn't a very far cry from locating misplaced children or identifying defense plant workers through the medium of plastic materials, to the replacement of brass, copper, aluminum and similar metals in Navy equipment nameplates, or in tags, markers and insignia used on heavy industrial machinery throughout the country. And here again plastic materials, techniques and facilities are available and adequate. It has been estimated that a single ship may have as many as 16,000 different nameplates, and it is almost impossible to guess at the number of markers on machines in industrial plants today. For many of these, plastic materials are now being used.

One of the most flexible methods of producing nameplates for this purpose is the acid etching of cellulose acetate sheet plastic. Nameplates produced in this fashion are reported to have a permanence and legibility not readily attained by other methods. The etching process makes possible combinations of etched and unetched areas which can be controlled to give a wide variety of effects at a cost which is said to compare very favorable with that of metals. The method of etching plastics is very similar to the venerable and established process, applied to metals, of blocking out sections of the material to be etched with a suitable "resistant," after which the exposed sections are etched with a proper solvent to the desired depth. After the etching is accomplished, the back-

FORWARD = STOP = REVERSE
CAUTION
TUMBLER HANDLE MUST BE IN OUT POSITION WHEN PICK OFF GEARS ARE BEING USED
HARDINGE
LOW = STOP = HIGH

2

3

PHOTOS, COURTESY MICA INSULATOR CORP.

2, 3—***Sharp legibility, oil- and chemical-resistance and good impact strength make engraved laminates eminently suitable for use as heavy industrial machinery markers***

ground is colored, while the resistant still covers the highlights of the letters. The resistant is then removed, leaving the highlighted letters in the color of the plastic material used.

The plates may be stamped with serial numbers by the same method employed in stamping metal; and they can be secured to the equipment for which they are intended in much the same manner as a metal etched plate is fastened—with brads or floating rivets—except that additional precaution must be exercised in driving the screws so that the pressure will not damage the material.

In the past, the metal surface on which etching had to be done remained the color of the metal itself. But plastic materials provide unlimited freedom in the choice of colors, and in the creation of unusual visual effects because cellulose acetate sheet plastics are available in a wide variety of transparent, translucent and opaque colors, as well as in mottle and special finishes. The etched surface is permanent and indelible, unlike inked surfaces which may react with chemicals and solvents used to service machinery and industrial equipment. Areas may be provided on etched plates for fill-ins in ink, or by means of stamps, of such variables as serial numbers, and such other information as may require individual attention. Large or small quantities of any plates or insignia may be produced by this process with a minimum investment since no die charges of any kind are involved.

Many thermosplastic sheet materials have long been employed in similar applications—identification badges for workers in defense plants—as well as in a multitude of diverse applications—radio dials, automobile clocks, speedometer indicators, aircraft plotters, calculators.[1] Most sheet stock available in practically any color of the spectrum, as well as in transparent form, can be printed in any number or variety of colors, including four-color processing as well as offset.

Printing on nitrate sheet, for example, is a highly skilled matter, comparable to printing on glass, and one of the most important factors contributing to the final printing job is the polishing operation. After the printing is thoroughly dried and well seasoned, the sheet plastic is placed between highly polished chrome plates, and under tremendous heat and pressure the surface is melted, and then quickly chilled by running cold water through steam pipes. The process is similar to that involved in the application of a glossy finish to a photograph, and the sheet plastic is peeled from the plate just as the photograph is taken from the polishing plate. Timing and the application of heat and pressure figure significantly in this operation because a miscalculation may ruin an entire printing job in its final stages. The material may be resolved into any shape or form required by a blanking operation, at which time corners are rounded, holes pierced and slots punched. Outside shapes are cut evenly and smoothly by the use of steel dies and punch-press equipment, and there are practically no restrictions on the number and variety of shapes that may be achieved.

The same inks and printing methods are generally applicable to cellulose acetate sheet, provided that less heat is used, since acetates are softer than nitrates. One new method has recently been developed for protecting printed cellulose acetate sheet plastic which is said to short-cut press-polishing or laminating technique. Ideal for short runs, it applies to the printed sheet a liquid film of cellulose acetate, coupled with a suitable solvent and plasticizer.[2] The coating reported to be nonpeeling, is applied by means of a new printing process, and is described as superior in strength to either the laminated or the press-applied finish. The same company which created this technique has also evolved a method for dyeing cellulose acetate butyrate and cellulose acetate which it claims may be used for sheet stock, molded items and extruded shapes.

Reverse printing of laminated cellulosic material is another process that has been extended successfully to sign-making and nameplate fabrication. In this process, the printing is applied on the back of the clear surface sheet which is then laminated to the structural base, resulting in an end product that is rust- and corrosion-proof, impervious to salt spray and to other outside factors that may interfere with the service of a sign on a ship, a tank, or on electrical equipment. It is also possible to laminate finished signs with lightweight transparent material on which the machine or motor numbers are stamped, without damaging the background.

Laminated thermosetting plastics

Perhaps the most spectacular use of plastic materials in this general classification has been for blackout signs and

[1] See MODERN PLASTICS, October 1941, p. 68.
[2] MODERN PLASTICS, May 1942, p. 54.

airplane instrument panels, fabricated of plastic laminates incorporating fluorescent material. The imminence of black-outs in coastal cities, as well as on all ocean-going ships and planes, has increased the importance of, and the interest in, such signs as applied to directional plates, instrument panels in planes and ships, and in all connections where mechanical and electrical devices are employed. One development consists of a laminated plastic plate printed in phosphorescent and fluorescent inks which glow brightly in the absence of visible light. The phosphorescent type is activated by ordinary white, visible light, and will retain legibility for about two hours after the light is turned off. The fluorescent type is activated by "black" invisible, or ultraviolet light, from a mercury vapor lamp containing a blue ultrapurple filter screen, and remains legible as long as the ultraviolet light is thrown upon it.

Graphic-type laminate stock is used in this application. The lettering is protected by a clear resin surface sheet which prevents injury to the legends from grease or cleaning solution, and provides resistance to wear from abrasion or scratches. The fluorescent substance is incorporated into the sheet below several layers of resistant plastics so that the light appears to be coming from within the dull-finish surface. The rest of the unit consists of structural backing. The letters are machine printed, with the size and spacing designed to assure immediate legibility, and several colors may be employed for variety and emphasis. The plates are usually $^{3}/_{64}$ in. to $^{1}/_{8}$ in. thick, and are screwed into place approximately 25 in. from the source of the ultraviolet light. Fluorescent laminates are now being used extensively in ship corridors and on bombing and pursuit planes for nameplates, pilot's switch panels,[3] instrument markings, etc., where an escaping gleam of light may be a shout to the enemy.

Engraved laminates also have been specified for naval, military and industrial uses. To make signs by this process, a "sandwich" type sheet is used in which letters, designs and figures are engraved or cut through the opaque surface exposing the contrasting sub-surface layer or core. The sharply relieved letters make for a sharp, clean-cut sign, with a permanent message that defies time and the elements. Engraved laminates are sturdy, easily drilled and machined and mechanically strong. The material is in general use now for display signs, nameplates, apparatus panels and a score of related products.

Vulcanized fibre

When the foundations for the vulcanized-fibre industry were laid way back in the 1870's, the present war emergency could not have been even remotely anticipated, yet this material is today doing a heroic job as an alternate for precious metals now no longer available for industrial uses. Its tough horn-like properties, high dielectric strength, excellent machining and forming qualities, high resistance to wear and abrasion, durability, shock-resistance, lightness of weight and ease of fabrication are all qualities that are being widely sought after to fulfil special requirements on the industrial front. Die struck and stamped vulcanized fibre nameplates and industrial markers are finding increased uses and value every day.

Special equipment

Various types of special equipment and processing for marking, printing and embossing plastics have been easily adapted to the extended use of plastic materials for nameplates and insignia. One company has recently announced the development of a simultaneous indenting and inking machine described as capable of producing completed nameplates with a minimum amount of time and motion. The machine operates through the use of etched or engraved steel printing dies which are heated by an electric, thermostatically controlled printing head. Special marking compounds are used with the heated printing dies which are said to accomplish the deep indentation of the plastic part without blurring, clogging or caking. One of the special features of this machine is the method of holding the variable detail in the steel printing plate, accomplished by the extremely rapid interchange of voltages, serial numbers, wattages and other designations within the fixed outline of the general plate. The same equipment can also be used for filling in specialized information on multi-color thermoplastic plates already printed. One special type of this equipment takes a roll of vulcanized fibre and automatically prints, punches and stacks it into identification tags, markers and nameplates used in place of metal units.

4—Flexible markers for bombing planes and battleships are made from rust- and corrosion-proof cellulose acetate. 5—All-important identification tags of cellulosic sheet

PHOTOS, COURTESY CELANESE CELLULOID CORP., GRUVER MFG. CO.

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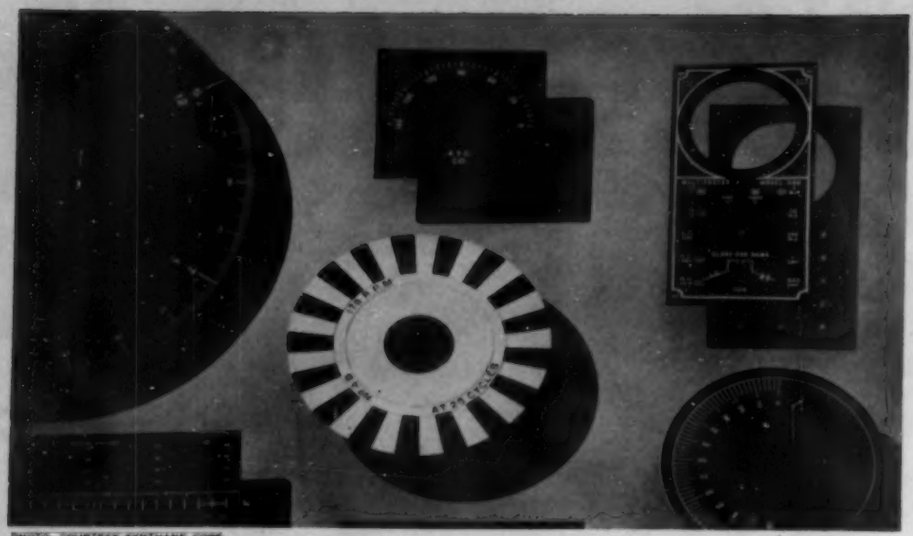
5

[3] See MODERN PLASTICS, Sept. 1941, p. 43.



PHOTO, COURTESY SYNTHANE CORP.

6

6—These instrument dials of phenolic laminates are shock-resistant and tough enough to withstand the onslaughts of time and the elements. Characters and figures are sharply defined, and the surfaces easily cleaned

Another time-proven process in use is roll leaf hot stamping, which is a combination of engraving and printing. The equipment for this process consists of a roll leaf hot stamping press, a supply of roll leaf in various colors and roll widths, an electrical heating plate with thermostatic control and the necessary steel or brass dies or type. The heated type or die is stamped into the surface of the plastic material through the web of roll leaf, thus transferring the coloring of the leaf to the surface of the plastic. In the stamping process, the plastic article is placed under the head of the press, which is equipped with a heated die and a roll of leaf passing across the surface of the die. With each impression of the press, the die is forced into the surface of the plastic, transferring the color from the leaf to the plastic object in a single operation. The stamped article is then removed or mechanically ejected from the press. No drying time is required, so that the article can be used at once for another operation, or packed for shipment. The fact that the roll leaf is fused directly into the plastic material during the operation makes it practically impossible to rub off, so that the identification or insignia may be expected to endure for the lifetime of the article. The process is being used not only in the fabrication of superimposed nameplates, trademarks and insignia, but also in applications where the "label" is an integral part of the surface of the product itself.

A simple and easily hand-operated lettering and numbering machine developed by one company is well suited for stamping pre-curved nameplates and parts. The ease of operating this machine has been described as an important factor in hastening the production of nameplates and machine parts which require accurate stamp details. In operation, the curved plate is lifted against the marking dial which is directed to stamp the desired letter or character. By swinging against a ratchet control, the nameplate is advanced for character spacing and an adjustment screw at the front moves the nameplate forward or backward for line spacing. On the face of the marking dial are prominent characters to permit quick selection of desired letters or figures, and a pointer indicates the character being stamped. The machine is being used for stamping of plastic and metal nameplates, and is described as being especially adapted to plastic stamping because there is no blow—just a steady, controlled pressure.

With the materials and machinery at its disposal, the plastics industry has set the pace of metal conservation by providing in its stead finished products that function with equal utility, efficiency and satisfaction, and in some instances, as in the fluorescent laminates, in a manner that surpasses previously used materials.

Credits—(items described and pictured) Materials: Bakelite cast resin, Fibestos, Nixonite, Nixonoid, Lumarith, Celluloid, Lucite, Vinylite, Formica, Lamicoid, Synthane, Insurok, National Vulcanized fibre. Fabricators: Ivorycraft Co., Inc., Cruver Mfg. Co., Bastian Bros., Eastern Etching & Mfg Co., E. J. Geary, Etched Products Co., Permanent Sign and Display Co. Equipment: Markem Machine Co., Peerless Roll Leaf Co., Acromark Corp.

PHOTO, COURTESY PEERLESS ROLL LEAF CO.

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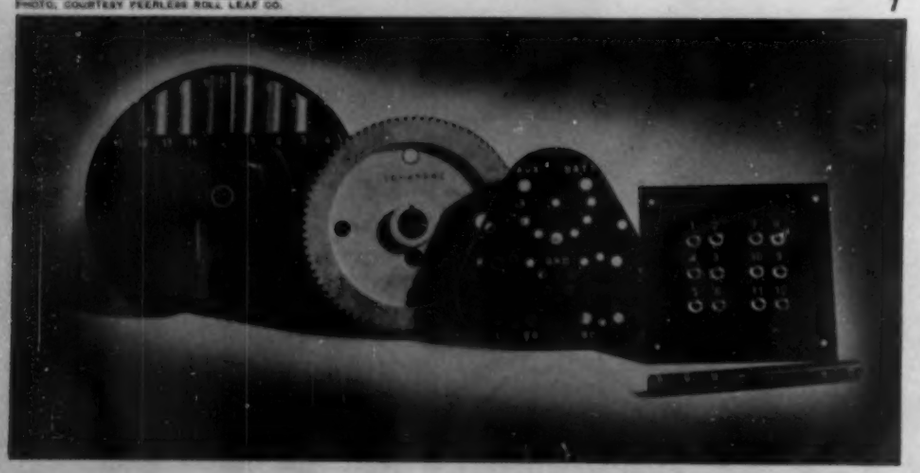


7—Phenolic and vulcanized fibre aircraft parts are permanently and indelibly marked by roll leaf hot stamping. The leaf is fused directly into the plastic material itself so that the legend will endure for the lifetime of machine parts marked

Night vision goggles

A CIVILIZATION that has succeeded in flooding night with the light of day is poor preparation for the specialized demands of wartime night-flying. The ability to function visually in total darkness has become a military strategic necessity, and one of the most important adjustments the pilot must make in wartime is learning to operate with precise and deadly accuracy in the dark.

Recently, modern science, with plastic materials as a faithful ally, has been successful in imparting to night pilots something of the special quality of owl vision. A new plastic dark adaptor goggle lens, designed to precondition the eyes of pilots to adequate night vision, has been perfected by one manufacturer working in collaboration with the Medical Research Section of the Bureau of Aeronautics. Dark-adaptation is the change that takes place in the light-sensitive elements of the eye when the intensity of the light entering the eye is reduced from the high level of daytime light to the low level of night light. The new goggle model, fabricated of plastic sheeting, consists of a single standardized unit, with interchangeable lenses—a non-polarizing red filter lens for dark-adaptation; a green-tinted polarizing lens which is an anti-glare filter; and a non-polarizing clear lens for wind protection. These lenses are given the optical precision of ground and polished glass by a new process.

The night-vision goggles are equipped with dark-adaptor lenses, based on the principle of a special lens which prevents practically all light stimulation of that particular portion of the retina which is employed in night vision. In the absence of such stimulation, that part of the retina becomes dark-adapted almost as rapidly as it would in total darkness; while normal visual functions may be performed with complete ease and efficiency with that part of the retina which is not employed in night vision. This preconditioning process is accomplished with the aid of a thin red color filter, bonded between two layers of optical plastic, which permits visual freedom through the use of those portions of the retina not used in night vision.

The company's engineers gave the frame of the goggle an entirely new basic design. It is a single-aperture type, providing unobstructed vision for both eyes without the usual nosepiece or hinge device. Fabricated from a single piece of sponge rubber and incorporating ventilating channels to prevent fogging, the frame is comfortable and lightweight, efficiently preventing light leakage, and at the same time eliminating the discomfort of previously designed models.

The new goggle represents a combination of scientific achievement and the adaptability of plastic materials. It is heralded as a long-felt need for pilots on aircraft carriers, and for men assigned to look-out positions, who must of necessity adapt themselves with a minimum of time and discomfort to seeing in total darkness.

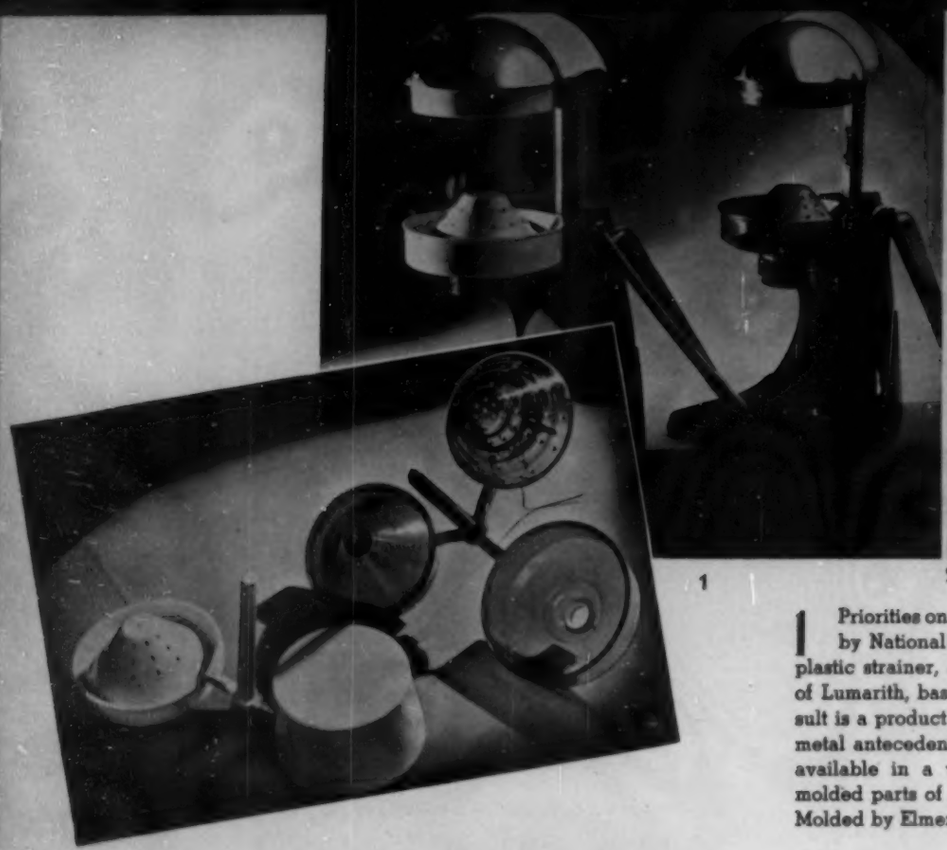
Prior to the development of this new model, personnel assigned to night duty were forced to begin their watch "blind" until their eyes could accustom themselves to the darkness in the normal 20–30 min. period required for such an adjustment. In some instances, preparation for a night watch took the form of a preliminary 20 to 30 min. in a dark room to precondition their vision. The new dark adaptor model makes it possible for a pilot to wear the goggles under full illumination, and continue with his normal visual duties while the preconditioning process is taking place. He may report to the "ready room" to work out his navigational chart, study his air plot, and then proceed to his duties in the plane with eyes sufficiently dark-adapted to begin work with no loss of time or efficiency. His night vision is so nearly adjusted as to require only $2^1/_2$ min. to achieve maximum night vision, the change having been effected with no time lost, thus eliminating a dangerous period of adjustment while he is actually on duty.

The new model, which weighs $2^1/_2$ oz. complete with headband and lenses, can be manufactured in quantities at approximately $^1/_6$ of the cost of antecedent models, it is reported, and eliminates entirely the need for metal, leather and cloth employed in earlier goggles.

Credits—Manufacturer: Polaroid Corp.

All-purpose goggle with rubber frame, fitted with plastic lens with non-polarizing filter (top), helps night-flying aviators adjust quickly to darkness. Replacement lens, (below) for wind or glare protection type, is easily inserted

PHOTOS, COURTESY POLAROID CORP.



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PLASTICS IN REVIEW

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1 Priorities on the march alter the aspect of the Juice King made by National Die Casting Co. The new unit is made with a plastic strainer, and upper and lower compression cups molded of Lumarith, based on Hercules cellulose acetate flake. The result is a product that is considerably lighter in weight than its metal antecedent (shown at far right), easier to keep clean, and available in a variety of attractive colors. Opaque injection molded parts of another model are also shown in photo, at left. Molded by Elmer E. Mills on Reed-Prentice injection machines

2 Transparent plastic splints for sprained or broken wrists are available in three sizes from the A. S. Aloe Co. Prefabricated from Plexiglas in shape of wrist support, they keep injured portion of arm immobilized but allow free use of fingers. Transparency permits x-rays without disturbing the support, and it is reported that the plastic is less irritating to skin than heavier metals previously used

3 Textile temple rolls made of special Vinylite tubing, extruded by U. S. Rubber Co. and fabricated by Roger W. Cutler, meet tough specifications necessary in processing rayon and silk textiles. They are abrasion-resistant and odorless, and maintain a tenacious grip because of their rough, spiral surface cuts. Two left-hand sections in photo are parts of temple rolls showing wooden cores which are inserted. Plastic tubing is at right

4 It's no military secret that medical staffs in service as well as numerous civilians are finding these Durez molded syringe cases compact and useful utility boxes. Molded by T. F. Butterfield, Inc., for Field Mfg. Co., these cases are sturdy, lightweight, and satisfactorily resistant to the action of changing temperatures

5 Seamless transparent Tenite tubing, from 3/8 to 3/4 in. in diameter, extruded by Extruded Plastics, Inc., and distributed by Julius Blum & Co., is said to be virtually unbreakable, yields readily to bending and curving to fit practically any condition. Troublesome weld marks and joints are eliminated in the fabrication, and the ends may be easily adjusted to standard flared fittings with the same tools that are used for copper tubing

6 New Radio Ear was designed by Peter Muller Munk for E. A. Myers & Sons and molded of Durez by Rathbun Molding Corp., to appear as small as possible, and to avoid even the slightest excess of space and material. The plug is integrated with the main shape of the housing, which results in a compact unit with minimum shape distortion

7 Little things that do a man-sized job are these Plastacele industrial spacers formed from cellulose acetate sheet, by Industrial Products Suppliers. Made in thicknesses from .001 in. to .020 in.,

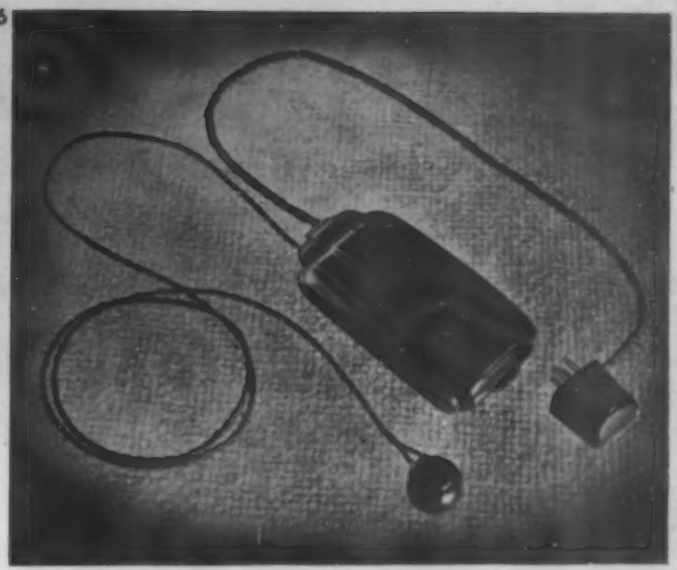
5

with a hole diameter up to as high as 2 in., and with standard keyways (larger sizes up to 10 in. are available), disks are being used on milling machines for the manufacture of widely diversified products. Ten different colors are employed to give each thickness an identifying color, eliminating lost time and motion of micrometer-caliper measurements, avoiding fitting and adjusting

8 With the range of industrial applications for plastic materials increasing daily, electrical applications are old friends, rapidly expanding in number. This contact block for a small pressure switch for water pumps, molded of Bakelite phenolic by Square D Co., serves as an insulating device for electrical contacts

9 A smart new barrel container for cigarettes is this compact, transparent receptacle, molded by Arpin Products for Sig. Dawer. It holds a full package of cigarettes, and is available in seven sparkling jewel tones to suit any interior

10 "Waste Not" is the by-word of all industry today, and a timely example of the useful application of waste material is this Plexiglas knife sheath which is worn by packing house workers. Sheaths are fabricated by the House of Plastics from pieces of acrylic scrap—residue of aircraft applications. They are not only lighter in weight than the aluminum items replaced, but have a clean, sanitary appearance, can be easily washed



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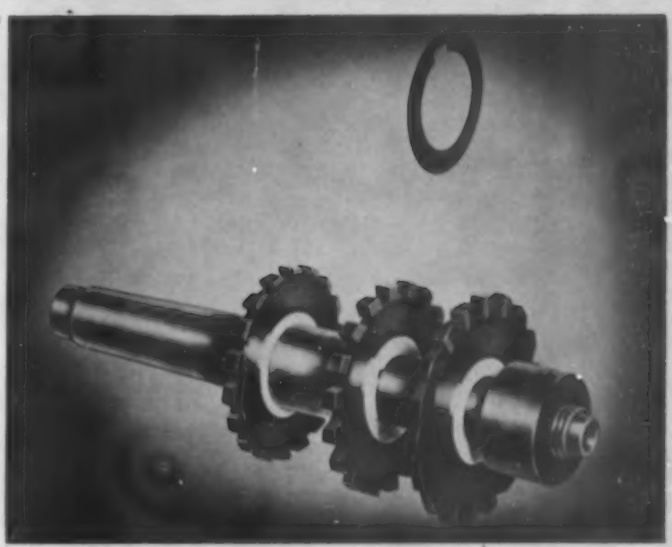

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Office equipment, modern style

THE replacement of the golden oak roll-top desk by the commodious flat-topped variety now serving the up-to-date businessman symbolized the acceleration of the more leisurely office routine of the last century. With the adoption of plastic exterior trim for its product, a large manufacturer of business equipment has taken another step in the direction of sound design, modernity, efficiency and good looks.

Plastic hardware first appeared on the Streamliner executive series of Globe-Wernicke Co.'s steel office equipment some two years ago, and was so favorably received that its use was extended to other lines. Now drawer pulls and handles, thumb latches, knobs and label holders designed in plastics are adding to the appearance of desks, filing cabinets, sectional bookcases, cupboards, visible record cabinets and other items of equipment put out by the company.

Most of the trim is injection molded of cellulose acetate butyrate, a material that is tough, hard, chip-proof and won't tarnish. Because color is an integral part of the plastic, the hardwear won't develop dingy spots where the color has flaked off under the constant pressure of warm fingers. Colors harmonize with the finishes of the equipment itself.

Compression molded urea formaldehyde and phenol formaldehyde plastics have been used for some of the larger drawer pulls. These materials are exceptionally strong, lightweight, shatter-proof, and their hard, smooth surfaces will not show wear. Their solid color is permanent, and threaded metal inserts are molded-in.

The head of the company's design department, Francis Braun, is responsible for the design of all the trim with the exception of the urea and phenolic handles, which are stock molds. Mr. Braun has rounded the corners and edges of his label holders for files and insert drawers, and constructed them so that labels will slip in at the side to eliminate the dust-collecting opening at the top. His guide rod knobs and thumb latches are broad-faced, easy to grasp. The smooth, sleek surface of the plastic, its clear, uniform color blend with the equipment and give each piece an effect of harmonious modernity.

Credits—Material: Tenite II, Plaskon, Bakelite. Molded by Molded Plastic Div., Reynolds Spring Co., and Grigoleit Co.

1—Dignity and simplicity characterize this executive office equipment built along modern lines. The plastic trim is molded in colors to harmonize with the furniture's finish. 2—A group of plastic drawer pulls, knobs and label holders in phenolic, urea and cellulose acetate butyrate. Their strength and durability belie their light weight, and they neither dent nor chip

Vinsol resin—extender and modifier

BECAUSE of its combination of unusual properties, availability and low cost, Vinsol* resin, a material extracted from southern pine wood, is said to have many uses in industry and to offer a wide range of possible applications. The fact that there is a large potential supply of this resin at a comparatively low price should make it worthy of investigation by manufacturers of plastics, protective coatings, insulating materials and many other products.

The resin is one of the products of the steam distillation process by which naval stores are extracted from wood of the long-leaf pine. This wood, removed from the cutover lands of the South, is taken to the manufacturer's plants, where it is chipped, shredded and treated to remove the naval stores materials, turpentine, pine oil and rosin. From one group of the oleoresinous constituents of this wood comes Vinsol resin.

The resin is a dark, brittle, high-melting thermoplastic material, black by reflected light, but dark red when viewed by transmitted light through a film. The coloring matter is lightfast and is not affected by contact with acids or alkalies. For greatest convenience in use the resin is made available in three forms: thin flakes, powder and solid lumps. The pulverized material has the unusual property of remaining pulverized when stored under normal conditions of temperature and humidity. It is soluble in alcohols, esters, ketones, terpenes and rosin derivatives; partially soluble in aromatic solvents, and insoluble in petroleum fractions.

The following table gives a typical analysis of the material:

Melting point (Drop method)	115.0° C.
Acid number	93
Gasoline soluble matter	12%
Toluene insoluble	20%
Ash	.2%
Methoxyl content (Zeisel method)	6%
Non-carboxylic hydroxyl content (Zerewitinoff†)	9%
Approximate molecular weight (Rast)	450

† Pyridine solvents.

Because of its exceptionally high dielectric strength, low power factor at elevated temperatures and excellent resistance to electrical currents of high voltage, this resin is described as a valuable ingredient in insulating compounds and finishes for electrical equipment. The resin is reported to be resistant to water, oil, grease and many chemicals.

An outstanding characteristic is its compatibility with cellulose derivatives and with most natural and synthetic resins; many combinations of Vinsol as a modifier or extender with other resins, rosin, and cellulose derivatives, are possible, yielding compositions having interesting properties. For example, it can be toughened by the addition of ethyl cellulose; the properties of the resulting product vary with the amount of ethyl cellulose and type of plasticizer used. Such mixtures hold considerable promise as thermoplastic compositions for a wide variety of purposes.

Vinsol can be reacted with aldehydes to yield high melting materials. It can also be used as a modifying agent for glycerol-phthalate resins, glycerol-maleate resins, phenol-aldehyde resins, etc., to form dark-colored resins of exceptional hardness. Reaction products of this type look like good materials for use as low cost extenders for phenolic and other resins in molding powders, phenolic plywood adhesives, molded and impregnated brake linings, etc.

* Trade name of material produced by Hercules Powder Co.

From chips of southern pine, shown above flowing into a steam distillation extractor at a naval stores plant, come oleoresinous materials which produce a new thermoplastic

The high dielectric strength, low power factor at high temperatures and ability to stand electric impulses of tremendous voltage indicate that it is an interesting material for use with high frequency currents and shows promise for this type of work. When tested between one-inch disk electrodes spaced 0.1 in. apart, with 60-cycle alternating current, the potential increasing at the rate of 1000 volts a minute, breakdown occurs above 20,000 volts at 85 deg. C. At lower temperatures, the breakdown potential will run as high as 50,000 volts.

Power factor and dielectric constant readings obtained on a typical sample of the resin by approved methods with 60-cycle alternating current are shown in the following table:

Temperature, degrees C.	*Power factor*	*Dielectric constant*
103	.152	6.5
80	.119	5.18
62	.100	3.86
55	.052	3.29
37	.009	2.87
25	.005	2.81

Under standard test, the resin has withstood an impulse test of 2,000,000 volts without failure. Other materials commonly used for similar applications were found to fail at about 150,000 volts.

Its low cost, availability and special properties enable Vinsol resin to be utilized quite (*Please turn to page 102*)

PLASKON

Link Bubble Sextants, using Molded Plaskon parts, are in[illegible] large numbers by the Allied Air Forces throughout the world.

Molded Plaskon is used for the delicate framework in the radiosonde, an aerial weather-reporting unit produced by the Washington Institute of Technology.

in Worldwide Wartime Service

PLASKON now is serving the war cause in many, many different ways—wherever the United Nations' armed forces are fighting throughout the world, and in auxiliary service on the home front.

In this wide range of applications, Plaskon special features are proving their ability to answer many of the industrial production problems that will come with peacetime. Such advantages as strength, light weight, inertness, non-conductivity, economy and speed in manufacturing operations once again will serve their product-developing, money-saving purposes when the war's over.

We shall be glad to cooperate with companies interested in developing the use of Plaskon Molding Compound or the urea-formaldehyde resins which we manufacture, for wartime or essential civilian needs. An experienced representative will call and discuss with you the services which Plaskon can offer to aid in the solution of your individual problems. Plaskon Company, Inc., 2121 Sylvan Ave., Toledo, Ohio. Canadian Agent, Canadian Industries, Limited, Montreal, P. Q.

PLASKON

TRADE MARK REGISTERED

MOLDED COLOR

Millions and millions of Plaskon Molded Color buttons are being supplied for clothing in every branch of America's armed forces.

Inlaying injection-molded parts

THE nature of kitchen utensils makes it essential that they be frequently scrubbed and sterilized in hot soapy water, and, above all, that they be impervious to sudden temperature changes.

When colorful metal-inlaid plastic handles for kitchen cutlery—a prewar luxury item—were first considered, it was found in early tests that constant immersion in water resulted in unsightly, unsanitary cracks between the plastic and the metal inlay. This was because the plastic material and the metal, having different coefficients of expansion, tended to separate. It seemed as if the attempt to produce such decorative kitchen equipment would have to be abandoned as entirely impracticable.

Not long ago, however, Sears, Roebuck & Co. introduced their new line of Sta-Sharp cutlery which featured metal-banded plastic handles. The problem had been solved. The ivory-hued cellulose acetate butyrate handles of the new product were injection molded separately, assembled to the stainless steel cutlery, and then inlaid with hot cast, non-corrosive metal. The fact that the temperature at which this cast metal flowed was considerably higher than the softening point of the thermoplastic cellulose acetate butyrate might seem to have presented an insurmountable obstacle. However, the use of a hard formulation of the plastic, relatively impervious to heat, combined with a low melting point metal, permitted the stainless steel (tool) to conduct heat away from the handle rapidly enough to avoid any damage to the plastic handle.

The injection molded handles are hollow and are constructed with an offset or shoulder which eliminates unduly heavy material sections, but maintains sufficient strength for useful service. The two circumferential grooves for the metal inlays on the handle are molded-in, as are the oblong holes on opposite sides of the handle, so that permanent anchorage of the metal is assured. To prevent the flow of metal to the bottom of the cored hole, a die cut piece of cardboard is inserted to rest on the shoulder. The casting is then placed in a pouring die, and the tang inserted, with just enough metal poured in to anchor it securely. Following this, it is placed in another die, and the decorative rings are filled with hot metal. The excess metal on the inlays and bolster is ground off on a wet grinding machine, until the proper contours are achieved, and the plastic surface is buffed and polished into a smooth, shining, high-luster finish.

The precision-fit of the metal into the grooved plastic sections makes separation of materials almost impossible even under the most severe service conditions. The comfortable, balanced weight of the finished implement is achieved by the proper adjustment of the size of the cores, and by controlled distribution of the cast metal used for anchorage and trim on the utensils.

Credits—Material: Tenite II. Molder: Elmer E. Mills Corp.

PHOTO, COURTESY TENNESSEE EASTMAN CORP.

Injection molded cellulose acetate butyrate in smooth, ivory tones, decoratively banded with metal, forms the handles of kitchen cutlery whose service ends are of stainless steel. By molding the hollow handles first, assembling them to the steel, and then pouring the inlay metal, the makers achieved a product which won't deteriorate or separate in hot water

1

PHOTOS, COURTESY JOSEPH MEYER BROS.

The lid is on

Clear protective shields for laboratory instruments and food counters prevent contamination, keep sanitation laws

PROTECTION—the watchword of the citizen, soldier, worker—must apply as much to property, to machinery and to work in progress as to physical wellbeing. Speed and efficiency are closely tied up with smooth functioning of every instrument; and with replacements often difficult or impossible to obtain, prices on the rise, it has become doubly important to safeguard intricate machinery, delicate laboratory instruments and other vital equipment.

Sturdy transparent covers, ranging from small precision instrument shields about 2 or 3 in. in diameter to tall cones or domes and to huge industrial shields many feet high and wide, are light, practically unbreakable and easy to handle. They are at present made principally from clear acetate, acrylic and ethyl cellulose sheet stock, and are readily formed to any regular or unusual contours. Rounds, ovals, squares, oblongs, L-shapes or odd shapes are possible, all without the necessity of expensive dies or molds. The plastic shields can be fabricated by forming under heat around a wooden arbor. For extra strength, one company has developed a bead construction at all edges or joints. This construction provides a perfect mechanical bind and fusing so that joints will not loosen, open or come apart. On small shapes and for strength at the bottom of a shield, a border of the bead can be wound around in a continuous piece, fused to the sides and made into an edging for the bottom, to a depth of about half an inch. For larger shapes requiring strength and rigidity, the plastic sheets are often built up with a plastic rail or are countersunk into a plastic or wooden molding.

A highly important use for such shields (see Fig. 3) is to cover microscopes, colorimeters, gages and other instruments. Correctly shaped, snug-fitting shields protect chemical mixtures or biological cultures from contamination. Food merchants, cafeteria managements (particularly in industrial plants where there is a great deal of smoke, chemical fumes or loose powder) make use of plastic shields to keep dust from food machinery and from open counters such as steam or ice tables (Fig. 1) and to cover cake and sandwich displays (Fig. 2). More exacting governmental regulations regarding food preparation and service have stimulated such uses.

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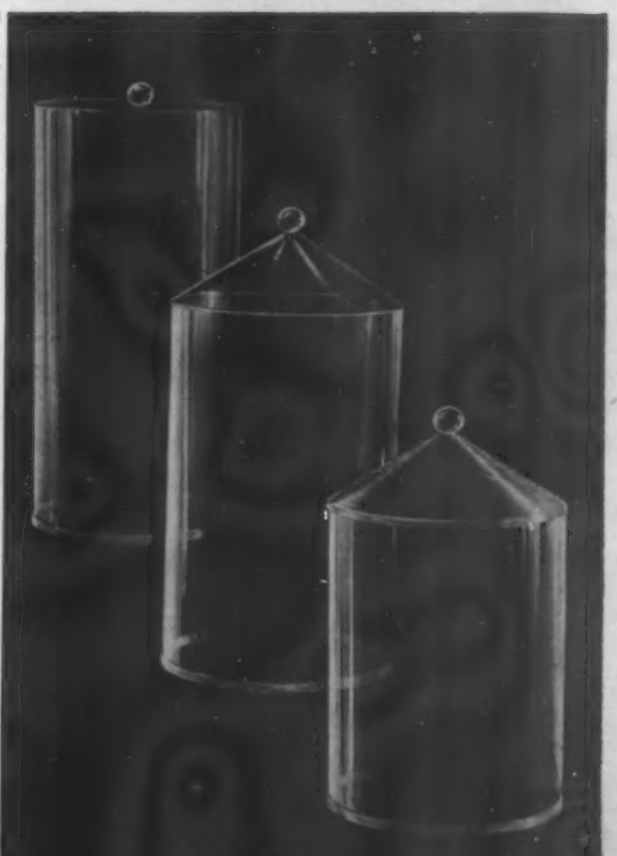

Stock molds

SHEET ONE HUNDRED-TWENTY

Drawer pulls, knobs, gear shift controls and buttons combine beauty and utility for hardware. Threads are molded in and decorative metal strips inlaid afterward. Available from stock molds without mold cost. Address Modern Plastics, Stock Mold Dept., Chanin Bldg., New York

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1430. Gear shift ball knob, 2 in. overall diameter. 1 7/8 in. overall height. 5/8 in. threaded opening

1431. Gear shift ball knob, 1 1/2 in. overall diameter. 1 7/16 in. overall height. 3/8 in. metal thread

1432. Conical top knob, 1 in. diameter; 1 in. overall height. 3/16 in. metal thread

1433. Conical top knob, 3/4 in. diameter. 7/8 in. overall height. 3/16 in. metal thread

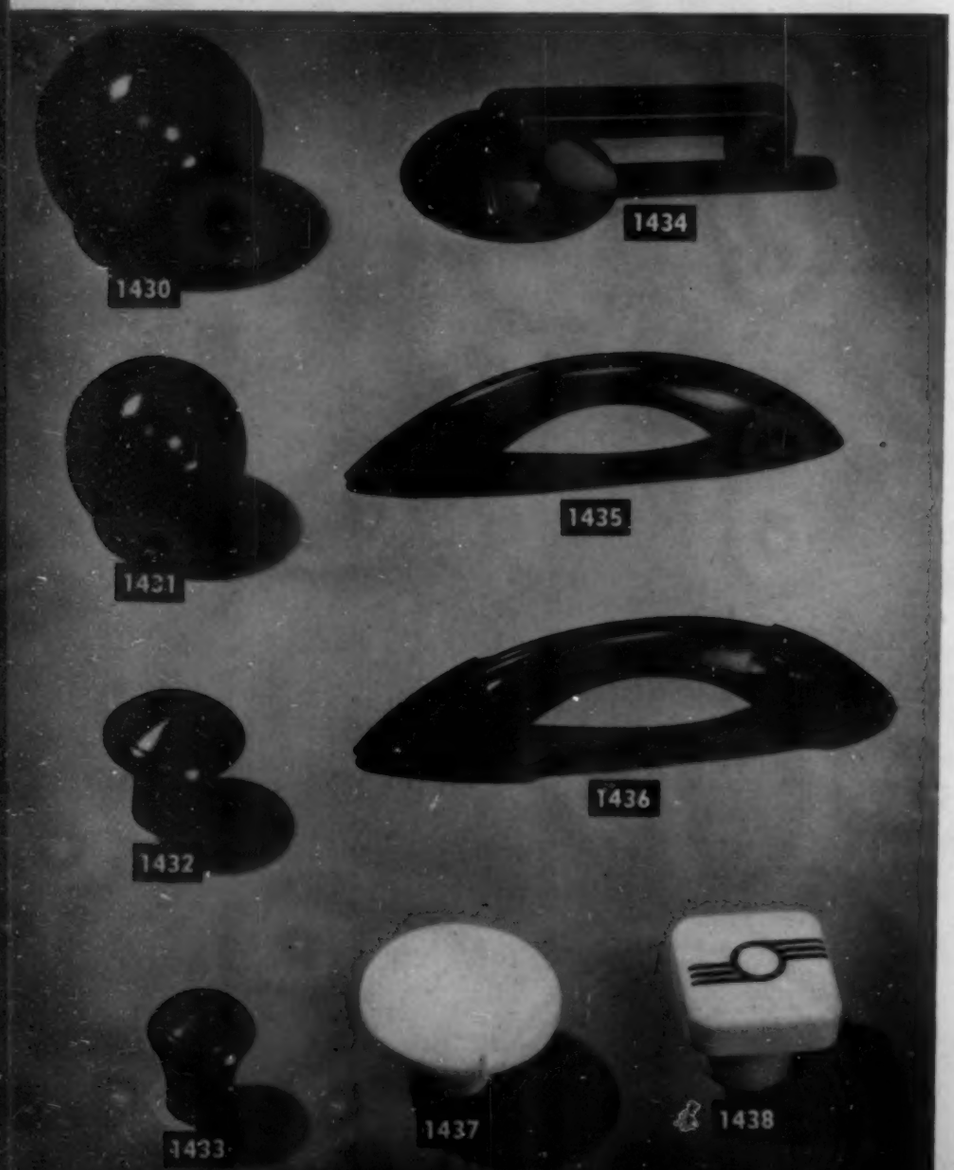
1434. Flat handle with 2 in. diameter metal escutcheon plate. 2 1/4 in. distance between centers. Length of handle 2 3/4 in.; width 1/2 in. Height 3/4 in. 3/16 in. threaded openings at each end

1435. Curved handle with 3/32 in. metal inlaid strip; cross-ribbed inside. 2 3/4 in. distance between metal threaded 3/16 in. centers. Overall length, 4 1/4 in. 5/8 in. at widest part. 1 1/8 in. high. Triple grooved decoration at ends

1436. Curved handle with 3/32 in. metal inlaid strip; cross-ribbed inside. 2 3/4 in. distance between 3/16 in. metal threaded centers. Overall length 4 1/4 in. 5/8 in. at widest part. 1 1/8 in. high

1437. Flat round knob, 1 3/8 in. diameter. 3/16 in. metal thread. 7/8 in. overall height

1438. Square knob with wiped-in contrasting colored decoration. 1 1/32 in. top. 1 in. overall height. 3/16 in. metal threads



Reprints of all stock mold pages which have been published to date, with a complete index of suppliers, are available to Stock Mold Service subscribers

All molders are invited to send samples from stock molds to appear on this page as space permits

Restrictions on supplies of raw materials, etc., may possibly limit production of some of these stock items. Please check molders on quantities available

DR. GORDON M. KLINE, Technical Editor

Fillers: swelling properties and structure

by R. J. KENT and J. SEIBERLICH

V. MEHARG[1] has investigated commercial fillers and has stressed their important functions in plastic compositions. Two classes of fillers are generally used, inorganic and organic. Inorganic fillers, such as asbestos and silica, have high heat resistance, high insulation, etc. Their disadvantage is their high specific weight. Organic fillers do not possess this disadvantage and are used on a much larger scale by the industry. Woodflour, cotton flock, rayon waste, powdered cellulose, etc., are on the market.

Woodflour is still most commonly employed, due to its low price. Some importance is attached to the rôle that the fiber structure of these fibrous fillers plays in improving the strength of the molded product. The fact remains, however, that in woodflour the fiber structure is almost completely removed. Cotton flock is also used extensively, but its bulky, fluffy form is difficult to handle in automatic presses. Alpha cellulose fillers are excellent in color but possess high moisture absorption due to their chemical pretreatment. The resin partly protects the filler but the susceptibility of this filler to water, acids and caustic solutions still remains. Any material originating from cellulose is subject in various degrees to attack by these chemicals.

Comparative tests were made on commercial fillers with respect to the volume of the materials in air, water and caustic solutions. Their respective microscopical structures were also studied. The results of these measurements are presented in this paper.

Raw materials investigated

The following commercial inorganic and organic fillers were tested:

Inorganic	*Organic*
Titanium dioxide	Walnut shell flour
Asbestos	Woodflour A and B
Dicalite A and B	Cotton flock, A, B and C
Zinc oxide	Cotton flock D (low swelling)
	Alpha cellulose flock
	Viscose rayon flock

Sedimentation test of organic fillers

Five grams of oven-dried material were put in a dry 100-cc graduate. The graduate was closed with a cork stopper and slowly shaken ten times. Finally it was placed upright and its content of filler was allowed to settle. The graduate was rotated to secure a fairly horizontal level of the material. The volume taken up by the filler was read in cubic centimeters every hour. It was observed that a maximum of swelling was reached in 8 hours.

The experiment was repeated after adding sufficient water to the five grams of oven-dried filler in the graduate to make a total volume of 100 cubic centimeters. Next, a similar test in caustic solution was performed, using enough of the 18 percent sodium hydroxide solution to make a total volume of 100 cubic centimeters.

The final sediment volume of the various fillers is expressed in cubic centimeters in Table I. The increase in the volume of the filler in water and in 18 percent sodium hydroxide solution as compared with its volume in air is given in percent.

From Table I it may be seen that in water nut shell flour swells less than any other cellulosic material investigated with the exception of the low-swelling cotton flock D; while in the caustic solution it shows greater swelling than the woodflours and some of the cotton flocks. Nut shell flour is characterized by a low sediment volume in air, which may be due to its nearly uniform size particle and shape. As may be seen in the microphotographs, all of the other cellulosic materials show more or less irregularity in particle size, which influences the bulk or sediment volume. There is no doubt that pretreatment of cotton flock D has considerably reduced its swelling capacity, while on the other hand the high-swelling degree of rayon waste is explained by its regenerated cellulosic character.

These organic fillers are derived from fibrous and nonfibrous cellulosic materials. As a consequence of their original the specific gravity of these fillers is as an average that of

[1] V. Meharg: MODERN PLASTICS *15* (1937), October, p. 46.
V. Meharg: MODERN PLASTICS *16* (1938), October, p. 30.

TABLE I.—BULK AND SWELLING PROPERTIES OF FILLERS

Contact medium	*Nut shell flour*		*Woodflours*				*Cotton flocks*								*Alpha flock*		*Rayon waste*	
			A		*B*		*A*		*B*		*C*		*D (Low-swelling)*					
	Volume, cc.	*Increase, %*	*Volume, cc.*	*Increase, %*	*Volume, cc.*	*Increase, %*	*Volume, cc.*	*Increase, %*	*Volume, cc.*	*Increase, %*	*Volume, cc.*	*Increase, %*	*Volume, cc.*	*Increase, %*	*Volume, cc.*	*Increase, %*	*Volume, cc.*	*Increase, %*
Air	13	..	33	..	26	..	42	..	43	..	14	..	16	..	21	..	11	..
Water	14	10	43	30	39	50	54	30	54	25	16	15	14	0	28	35	17	55
Sodium hydroxide (18%)	55	320	84	155	56	115	85	100	78	80	65	360	19	20	84	300	71	550

cellulose. Small variations are caused by impurities such as lignin, pentosans, coloring matter, wax, etc. It seemed permissible to neglect the effect which the specific gravity of these fillers has on their sedimentation volume.

Microscopic structure of fillers

To get more information about the properties and structural uniformity of fillers, they were inspected under the microscope in normal and in swollen condition. Figure 1 shows nut shell flour suspended in water and Fig. 2 shows the same material at a high magnification. It may be concluded from this picture that nut shell flour, due to its uniform, pebble-like shape, may be an ideal filler. However, it probably acts like the gravel in concrete without causing a web or an orientation effect. Figure 3 shows nut shell flour in a swollen state in caustic solution.

Figures 4 and 6 show the irregularity of woodflour. Figures 5 and 7 show woodflour in the swollen state. The swelling is slightly less than that of nut shell flour. The porous structure of woodflour capable of absorption of resins is especially evident in Fig. 8.

Figures 9 to 12 show two cotton flocks from two different sources. The fiber structure of this type of filler improves the impact strength of plastics. Such long fibers also become easily oriented in extrusion or injection molding. These pictures show how difficult it is to determine a special mesh size or grade of fineness for cotton flock. The various lengths of particles induced the authors to use a count method for rating particle content of these fillers. This will be described in a later section of this paper.

Figures 13 to 16, inclusive, show another cotton flock but in comparison with the material of Figs. 9 to 12 it may be noted that this cotton flock shows less original fibers and quite sharp, cut edges. The same may be said of cotton flock D (Figs. 17 and 18) but this pre-treated material shows much less swelling in sodium hydroxide solution which might be of great advantage for a filler in certain plastics.

Alpha flock (Figs. 19 and 20) is a wood pulp product obtained by treatment of the bleached wood pulp with dilute caustic solution. The photographs still show the typical wood fiber in more or less large fragments. Again, the great irregularity makes it difficult to specify the exact mesh size. Since this material has already passed through a caustic pretreatment, its swelling degree is considerable. The advantage of alpha pulp is its pure, white color and low specific weight as compared with inorganic, pure, white fillers.

Rayon waste shows the typical shape of rayon yarn (Figs. 21 and 22) but it also shows that it is possible to obtain a more uniform grade by special milling methods. Being a precipitated cellulose, its swelling degree, of course, is high in water as well as in caustic solution. This may be the main obstacle in introducing it as a filler.

For comparison of the particle size and structural uniformity of these organic fillers with those of normal inorganic fillers, Figs. 23 to 27 are included. With the exception of asbestos (Fig. 25), all of the fillers show much greater uniformity and more homogeneous particle size.

Microscopical counting technique

In order to get a numerical expression of the particle uniformity of the organic fillers, a microscopical count method similar to that used in blood examination was developed as follows:

Preparation of the microscopic slide. Two grams of the commercial filler were suspended in 400 cc. of water at room temperature. In the course of the following fifteen minutes the suspension was stirred thoroughly several times. With the material well suspended, a pipette was filled from the central part of the liquid and, after discharging the first drops, one large drop was placed on a slide. This drop was large enough to spread under the cover glass without leaving excess fluid. The suspended material always tended to gather in the central parts of the drop. To secure the most even distribution of the suspended material on the slide, the cover glass was quickly put in place. It was found that holding the cover glass at an angle to the slide, permitting the drop to accumulate at this angle, and then lowering the cover glass onto the slide, resulted in gross disturbances of the distribution of the particles. Squeezing out of liquid from beneath the cover glass was also avoided as it had the same undesirable effect. The preparation was then placed onto the stage of the microscope and examined after all particles had come to rest. No staining was employed.

Method of counting. The preparations were examined under a linear magnification of fifty through an eyepiece equipped with a micrometer ruled into 0.25 mm. squares. In adapting methods used in the medical field for counts of microscopical elements, the following rule was observed. The count started with the left upper square and progressed to the right along the horizontal row of squares. All particles counted were within each square or extending into it over its left or upper border; not counted were particles extending from these squares into the following lower row of squares or extending over the right border of the last square. With the first line of squares finished, the count continued again from the left side with the second row. Therefore, when the last row of squares was reached, those particles extending from it over its lower and right border were not counted. If necessary, the micrometer scale was adapted to fibers running in odd directions by turning it with the eyepiece. But generally it was possible by experience to classify each particle by estimating its size, after the first estimations had been checked by comparison with the micrometer scale.

Classification. In all counts done by means of the described method and equipment the lateral length (0.25 mm.) of one square of the ocular micrometer at a linear magnification of 50 was taken as the unit of length. Under these conditions, 0.25 mm. of the ocular micrometer represents 0.005 mm. on the slide. The particles were classified into groups as follows:

Group 0: All particles of pinpoint size, not showing any fibrous origin.

Group 1: Particles having dimensions not larger than one-third of the unit of length in either direction.

Group 2: Particles clearly visible as fractions of fibers and of a size not larger than one unit in either direction.

Group 3: Particles clearly visible as fractions of fibers and of a size not larger than two units in either direction.

Groups 4 to 9: Each group represents an increase in particle size by one unit in either direction.

Group 10: All particles larger than those of Group 9 (i.e., larger than eight units in either direction).

The same principles were applied to the one filler which was found to consist almost entirely of approximately globular particles (nut shell flour).

Results of counting experiments. To check the method itself, ten counts were made on one filler. For each count, the pipette was filled anew from the well-suspended material and a fresh slide was prepared. It was proved that by means of the described method the original distribution of the mate-

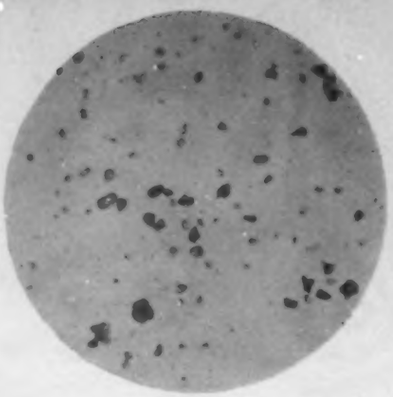


Fig. 1
Nut shell flour in water
Magnification: 50, linear

Fig. 2
Nut shell flour in water
Magnification: 560 linear

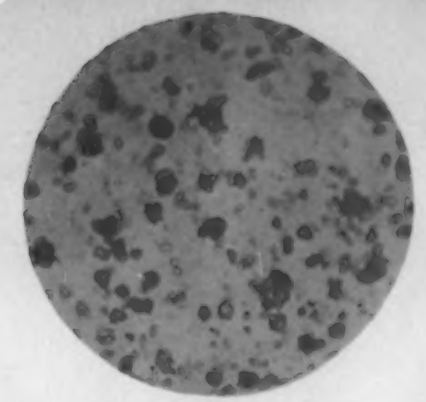


Fig. 3
Nut shell flour in 18% NaOH
Magnification: 50, linear

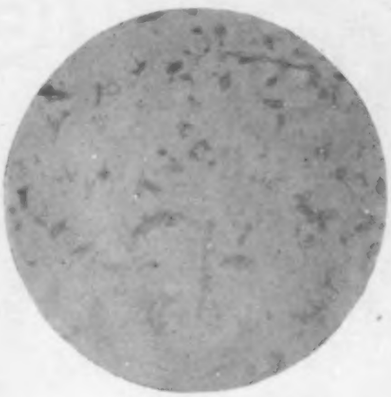


Fig. 4
Woodflour "A" in water
Magnification: 50, linear

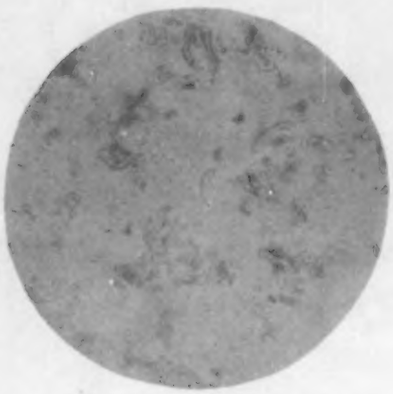


Fig. 5
Woodflour "A" in 18% NaOH
Magnification: 50, linear

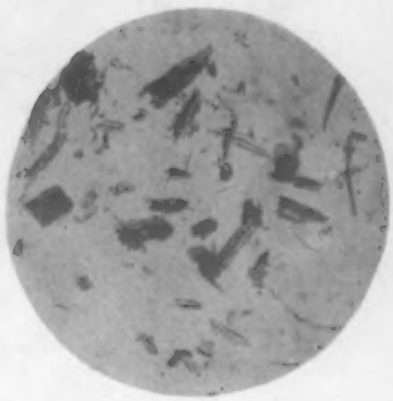


Fig. 6
Woodflour "B" in water
Magnification: 50, linear

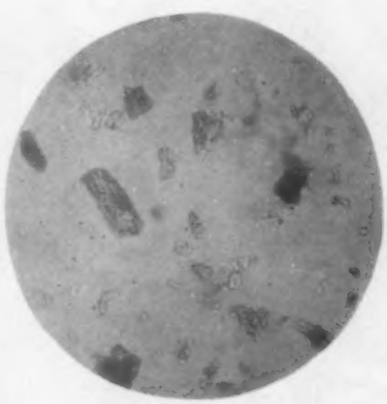


Fig. 7
Woodflour "B" in 18% NaOH
Magnification: 50, linear

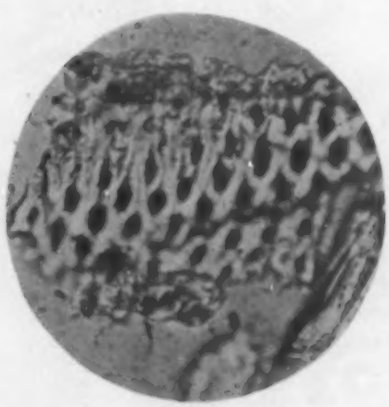


Fig. 8
Woodflour "B" in 18% NaOH
Magnification: 560, linear

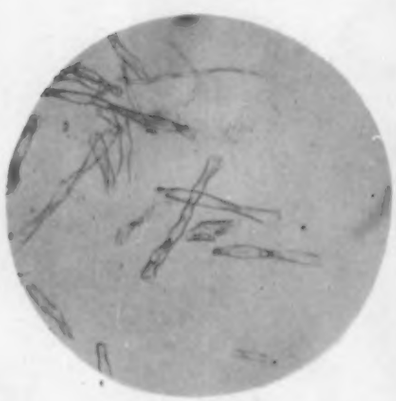


Fig. 9
Cotton flock "A" in water
Magnification: 50, linear

Fig. 10
Cotton flock "A" in 18% NaOH
Magnification: 50, linear

Fig. 11
Cotton flock "B" in water
Magnification: 50, linear

Fig. 12
Cotton flock "B" in 18% NaOH
Magnification: 50, linear

All cuts reduced by approximately one-fifth.

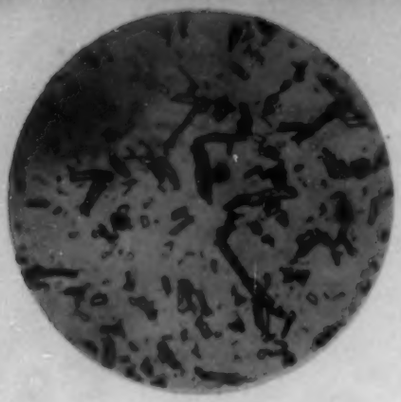


Fig. 13
Cotton flock "C" in water
Magnification: 50, linear

Fig. 14
Cotton flock "C" in water
Magnification: 560, linear

Fig. 15
Cotton flock "C" in 18% NaOH
Magnification: 50, linear

Fig. 16
Cotton flock "C" in 18% NaOH
Magnification: 560, linear

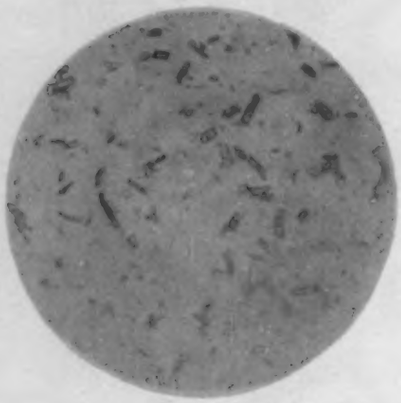


Fig. 17
Cotton flock "D" in water
Magnification: 50, linear

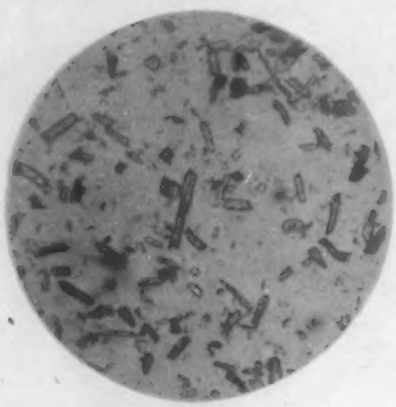


Fig. 18
Cotton flock "D" in 18% NaOH
Magnification: 50, linear

Fig. 19
Alpha flock in water
Magnification: 50, linear

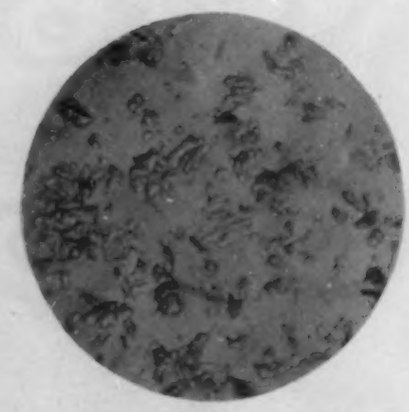


Fig. 20
Alpha flock in 18% NaOH
Magnification: 50, linear

Fig. 21
Rayon powder in water
Magnification: 50, linear

Fig. 22
Rayon powder in 18% NaOH
Magnification: 50, linear

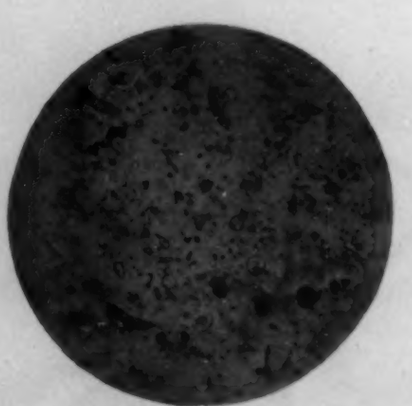


Fig. 23
Dicalite "A" in water
Magnification: 50, linear

Fig. 24
Dicalite "B" in water
Magnification: 50, linear

All cuts reduced by approximately one-fifth.

Fig. 25
Asbestos in water
Magnification: 50, linear

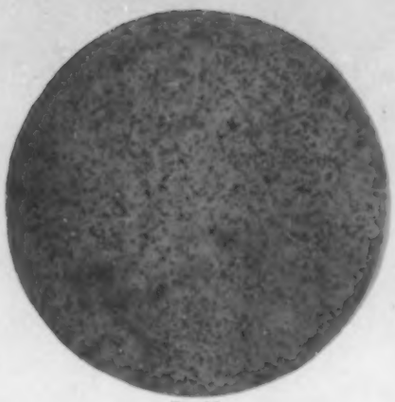


Fig. 26
Zinc oxide in water
Magnification: 50, linear

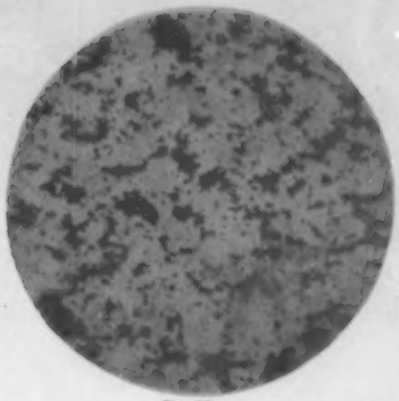


Fig. 27
Titanium dioxide in water
Magnification: 50, linear

All cuts reduced by approximately one-fifth.

TABLE II.—PARTICLE COUNTS FOR VARIOUS ORGANIC FILLERS[a]

Materials	*Groups*[b] 1	2	3	4	5	6	7	8	9	10
Nut shell flour	69	31	..	..	..	..	..	..	..	..
	61	38	1	..	..	..	..	..	..	..
Woodflour A	71	26	3	..	..	..	..	..	..	..
	72	24	4	..	..	..	..	..	..	..
Woodflour B	60	28	5	6	1	..	..	..	..	..
	64	28	8	..	..	..	..	..	..	..
Cotton flock A	18	21	23	16	6	7	6	2	1	..
	12	16	29	18	11	8	2	3	1	..
Cotton flock B	9	35	17	6	19	3	6	..	4	1
	16	44	12	5	6	9	2	2	1	3
Cotton flock C	52	41	7	1	..	..	..	..	..	..
	51	40	7	2	..	..	..	..	..	..
Cotton flock D	47	50	2	1	..	..	..	..	..	..
	50	47	4	..	..	..	..	..	..	..
Alpha flock	36	54	8	2	..	..	..	..	..	..
	38	57	5	..	..	..	..	..	..	..
Rayon powder	25	71	4	..	..	..	..	..	..	..
	16	75	8	1	..	..	..	..	..	..

[a] In each individual count, one hundred particles were counted; therefore, each figure represents the percentage of particles of each group in the entire suspension, exclusive of Group 0 particles.
[b] See text for the meaning of these group classifications.

TABLE III.—PARTICLE COUNTS RESTRICTED TO BULK OF FILLER

Materials	*Groups* 2	3	4
Nut shell flour	99	1	..
	100	..	..
Woodflour A	87	13	..
	83	15	2
Woodflour B	67	28	5
	72	21	7
Cotton flock C	74	22	4
	73	23	4
Cotton flock D	89	10	1
	87	13	..
Alpha flock	85	14	1
	90	9	1
	80	20	..
Rayon powder	90	8	2
	89	11	..

Because of the gross inhomogeneity of the cotton flocks A and B, no separate counts were made.

TABLE IV.—PERCENTAGES OF UNSPLIT AND SPLIT FIBERS IN VARIOUS ORGANIC FILLERS

Materials	*Unsplit fibers, %*	*Split fibers, %*	*Remarks concerning special types of fibers*
Cotton flock A	77	23	Very long, split, 9%
	81	19	Glassy, long, 9% Nearly square, 6%
Cotton flock B	64	36	Very long, thin, 12%
	67	33	Nearly square, 19%
Cotton flock C	26	74	Fibers clearly outlined
	29	71	No lumps, free ends ragged
	29	71	
Cotton flock D	27	73	Fibers clearly outlined
	29	71	No lumps, free ends fairly ragged
Alpha flock	16	84	Clearly outlined fibers, 5%
	20	80	Lumps formed by squeezed fibers
Rayon powder	71	29	Neat, smooth fractures
	66	34	

rial could be determined on the microscope slide. Thereafter, two counts were made for each filler. In case of gross discrepancy of the results, a third count was executed. For each count a fresh slide was prepared. In each count one hundred particles were counted. These results are shown in Table II. Group 0 particles are omitted, since they do not contribute appreciably to the bulk of the filler.

One series of counts was made to determine the distribution of the various sizes of Groups 2 to 4 particles, which make up the bulk of the preparations. Because of the gross inhomogeneity of cotton flocks A and B, no such separate counts were made for these materials. The results of these counts are given in Table III.

One series of counts was made to determine the percentage of unsplit and split fibers in the fillers. It was found that the particles classed in Groups 0 and 1 were nearly all split fibers; however, these did not contribute much to the bulk of the filler. Therefore, it was thought permissible to omit these two groups from the counts. In order to determine in extreme cases whether or not a fiber was unimpaired, the average thickness of the largest and longest elements of the preparation, seemingly unimpaired, was taken as standard. Results of these counts are given in Table IV.

(*Please turn to page 102*)

High impact molding compounds

by C. H. WHITLOCK and R. U. HASLANGER*

PHENOL-aldehyde molding compositions of high impact strength have been given new emphasis by the war program. There are two reasons for this emphasis: the need for plastics possessing high impact strength under wide ranges of temperature for severe military and war production applications, and the shortage of vital materials such as zinc, aluminum and other metals for die casting, copper and leather.

High strength phenolic molding compositions consist of two principal ingredients: the resin and a fibrous filler. The resin is important as the bonding agent for the filler, contributes to the water resistance, electrical properties, hardness and surface finish and, in part, determines the flow of the molding compound. Changes in the basic resin formulation are of comparatively minor importance in so far as strength is concerned. The nature of the filler largely determines the strength characteristics of the molded part, and contributes, to a considerable extent, to the moldability of the compound.

Where impact strengths greater than could be obtained with general purpose woodflour-filled materials were required semi-impact materials employing cotton flock as a filler have been in general use. Impact-type materials have been confined to what is known as macerated-fabric-filled or rag-filled types. These materials have proved adequate in the past for applications requiring good strength characteristics. The relatively few applications requiring greater strength were taken care of by the laminates, molded in flat or simple contours, and machined to the final shape.

Because of the demand for a moldable material possessing an impact strength 2 to 3 times that of the macerated-fabric-filled compositions, a wide range of fillers have been investigated and their effect on physical and mechanical properties and molding characteristics evaluated.

When macerated fabric is employed as the filler the impact strength is dependent on the particle size, the weight of the cord or thread and the thread count. It would be possible to obtain better impact strengths employing a much heavier fabric than is now being generally used. However, limitations are reached for this type of filler at a point where the flow characteristics are retarded because of the particle size and weight. At this point resin segregation becomes evident, as the resin tends to flow away from the heavy fabric giving a non-uniform molded piece with weak sections. Any attempt to advance the polymerization of the resin further, giving what is termed a hard or stiff flow, results in loss of plasticity, and unfilled molded pieces are obtained.

In molding compounds utilizing individual fibers as the filler, as compared to macerated fabric, it was found that fibers of much greater weight and accompanying strength will flow with the resin under heat and pressure to give a satisfactory molded article. As a result, high impact strengths were obtained in well-filled articles using string, cotton waste, sisal fiber, cord and similar fibrous fillers, thus eliminating the principal drawback to high strength fabric-filled materials.

After evaluating a wide range of fibrous fillers, a special twisted cotton cord was found to be the one best suited for use in producing a material with very high impact strength. This new moldable product possesses impact strengths superior to any of the other impact type materials now available.

Table I lists the more important physical and mechanical properties of the cord-filled material, as compared to those

* Monsanto Chemical Co., Plastics Division.

TABLE I.—PHYSICAL AND MECHANICAL PROPERTIES OF IMPACT GRADE PHENOLIC MOLDING MATERIALS

Properties	*Cord Filled*	*Fabric Filled*	*Cotton Flock Filled*	*Woodflour Filled*
MOLDING COMPOUNDS				
Particle Size	Cut cord	Macerated fabric	Passes U. S. Std. 10 mesh screen	Passes U. S. Std. 16 mesh screen
Apparent Density, grams per cc.	.18–.20	.10–.13	.23–.26	.52–.58
Compression Ratio	6.5–7.5	10.5–11.5	5.0–6.0	2.3–2.6
Flow	Medium hard	Medium hard	Medium hard	Soft, medium hard
MOLDED ARTICLE				
Specific Gravity, grams per cc., 25 deg. C./25 deg. C.	1.35–1.38	1.35–1.38	1.35–1.38	1.35–1.38
Specific Volume, cu. in. per lb., 25 deg. C./25 deg. C.	20.0–20.5	20.0–20.5	20.0–20.5	20.0–20.5
Shrinkage, in. per inch	.003–.005	.004–.006	.004–.006	.005–.007
Water Absorption, percent (A.S.T.M., D570–40T, forty-eight hrs., 25 deg. C.)*	1.0–1.5	1.0–1.5	.8–1.2	.5–1.0
Dielectric Strength, Short Time, volts per mil (A.S.T.M., D150–39T, 1/8-in. specimen, condition 96 hrs., 70 percent R.H., 25 deg. C.)	300–450	300–450	400–450	300–400
Ultimate Flexural Strength, lb. per in.² (A.S.T.M., D48–39)	13,000–14,000	11,000–12,000	10,000–11,000	9000–10,000
Deflection at Break in Flexure, inch (1/2-in. by 1/2-in. by 5-in. specimen, 4-in. span)	.095	.075	.065	.065
Ultimate Tensile Strength, lb. per in.² (A.S.T.M. D638–41T)	6500–7000	6500–7000	6500–7000	6500–7000
Impact Strength, Notched Izod, ft.-lb./in. of notch (A.S.T.M., D256–38)	7.5–8.0	2.8–3.2	1.2–1.4	0.28–0.32

* Specimens were conditioned according to paragraph 4a of A.S.T.M. D 570–40 T, and a 48-hr. immersion period was used instead of the 24-hour immersion period specified by the A.S.T.M. method.

filled with woodflour, cotton flock and macerated fabric. Data were obtained using A.S.T.M. methods on compression molded test specimens prepared under identical molding conditions. Tests were run at 25 deg. C. and 50 percent relative humidity.

In comparing the cord filler with the fabric filler, it may be seen that the former gives an impact strength of from 2 to 3 times that of the fabric filler. Ultimate flexural strength is about 10 to 20 percent above that of the fabric filler, while ultimate tensile strength is essentially the same for all four materials. The cord-filled molding compound possesses a further advantage over the fabric-filled material in that it has a substantially lower bulk factor or compression ratio. As might be expected, dielectric strength, specific volume, and specific gravity are practically unaffected by the fillers involved here.

The variation of the ultimate tensile strength, ultimate flexural strength and impact strength with temperature for cord-, macerated-fabric-, and woodflour-filled compositions is shown in Figs. 1, 2 and 3. Data are presented over a temperature range of from −80 deg. C. to 225 deg. C. (−112 deg. F. to 437 deg. F.).[1]

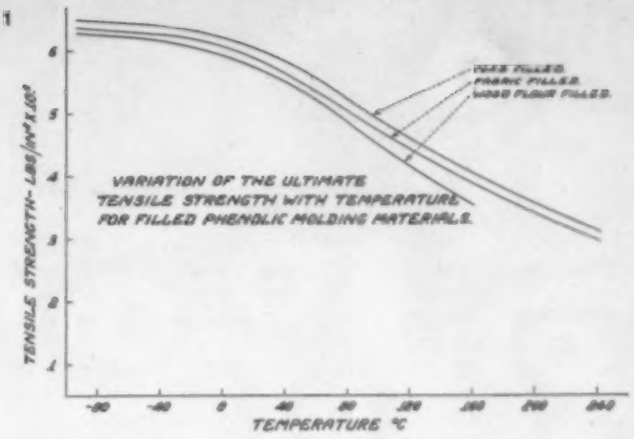
The tensile and flexural strengths for all three types of filler show a gradual decrease with increasing temperature. Over the normal temperature range, −50 deg. C. to 80 deg. C. (−58 deg. F. to 176 deg. F.), this amounts to a 10 to 15 percent increase or decrease from the value at 25 deg. C. (77 deg. F.). For both impact-type fillers the impact strength shows a gradual increase with increasing temperatures to a maximum at 160 deg. C. to 180 deg. C. (320 deg. F. to 356 deg. F.). At this point charring of the filler and resin begins to occur and the impact strength drops sharply. The change in impact strength over the normal temperature range, −50 deg. C. to 80 deg. C., is about 15 percent of the value at 25 deg. C.

There are many applications for which this new type of super-impact material is well suited, and in which it is already reported in successful use. The aircraft industry has been looking for a stronger material than those obtained to date. In many cases they have gone to the expense of machining parts from laminates in order to take advantage of the increased strength of this type of product. The Army Ordnance Department is interested in plastics with high impact strength to replace vital materials used in shell windshields, fuse parts, hand wheels and innumerable other objects. The use of impact materials by the Navy Department has been well established. Up to this time their requirements have been confined to materials of the macerated-fabric or cotton-filled types, chiefly because no moldable composition of higher impact strength existed. Because cord-filled compositions combine high impact strength with good molding qualities, they can be used to advantage for many parts which at present are made from materials of lower strength.

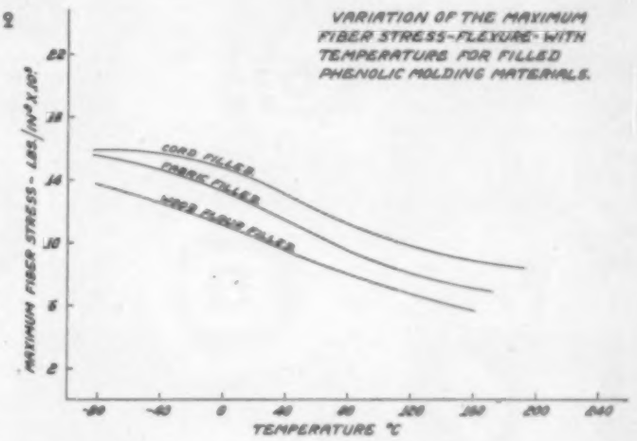
The general molding characteristics of this new material are similar to those for other impact materials. However, because of the uniformity of the cord, superior molding characteristics have been reported. The low compression ratio, as compared to fabric fillers, allows for ease in charging the mold. Resin segregation is minimized and flow characteristics are improved. Transfer molding of articles requiring high impact strength is facilitated by a cord filler. Impact strengths in transfer molded articles containing macerated fabric are naturally reduced as a result of the breaking down of the filler as it passes through the gates and sprues. The cord filler, being more uniform and having much better characteristics

[1] These data have been collected by the Research Dept., Plastics Div., Monsanto Chemical Co.

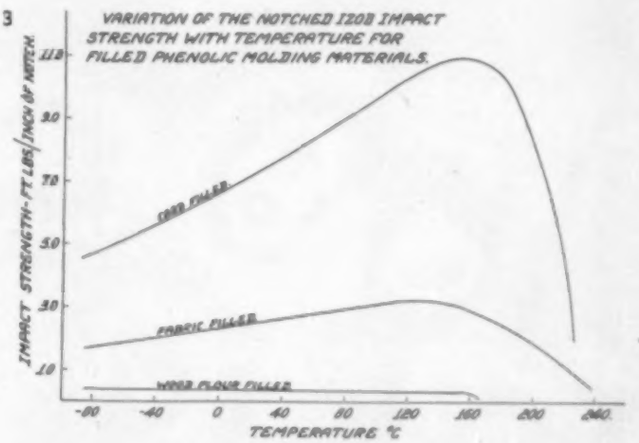
1


VARIATION OF THE ULTIMATE TENSILE STRENGTH WITH TEMPERATURE FOR FILLED PHENOLIC MOLDING MATERIALS.
TENSILE STRENGTH - LBS/IN² X 10³
TEMPERATURE °C

2


VARIATION OF THE MAXIMUM FIBER STRESS-FLEXURE- WITH TEMPERATURE FOR FILLED PHENOLIC MOLDING MATERIALS.
CORD FILLER
FABRIC FILLER
WOOD FLOUR FILLED
MAXIMUM FIBER STRESS - LBS/IN² X 10³
TEMPERATURE °C

3


VARIATION OF THE NOTCHED IZOD IMPACT STRENGTH WITH TEMPERATURE FOR FILLED PHENOLIC MOLDING MATERIALS.
CORD FILLER
FABRIC FILLER
WOOD FLOUR FILLER
IMPACT STRENGTH - FT. LBS./INCH OF NOTCH
TEMPERATURE °C

1, 2, 3—*Variation of the ultimate tensile strength, ultimate flexural strength and impact strength respectively with temperature for cord-, macerated-fabric-, and woodflour-filled compositions. Temperature range: —80 deg. C. to 225 deg. C. (—112 deg. F. to 437 deg. F.)*

for flowing through the gates without destroying the structure, produces a transfer molded article of excellent strength.

Twisted-cord-filled material has a very definite and useful place in the plastics industry. Because of its excellent physical and mechanical properties, as well as its high degree of moldability, it will answer the need for a high impact strength material to replace present types in certain applications where greater strength has been desirable, and for numerous new applications requiring the highest impact strength available.

Dilectene[1]—a new insulating material

by S. A. RULON*

WITH the number of varied uses that exist for an electrical insulating material, it is not surprising that so many should be available. However, this also serves to complicate decisions as to the proper material to use for a given application. Ideally, an insulating material should have low loss properties and a high dielectric strength. It should be electrically stable over a wide range of frequencies and regardless of surrounding humidity conditions. It should be strong enough mechanically to fit it for general application, and should possess good workability. It should have a minimum tendency to cold flow and warp, and should not be affected by changes in temperature over the normal working range of −50 deg. to +150 deg. F.

To date, no such ideal material has been developed, nor does it appear likely that such will ever be the case. However, the properties peculiar to a new commercial product known as Dilectene[1] are such that it approaches in many ways this ideal material. Briefly, this synthetic resin is claimed to have exceptionally low loss properties which change very little over the commercial and high-frequency range and are practically unaffected by surrounding moisture conditions since the resin itself is practically non-absorbent. Its dielectric strength is reported to be high, and its cold flow and tendency to warp found to be very slight.

Dilectene 100 is a pure aniline-formaldehyde synthetic resin, red-brown in color, which contains no cellulosic filling materials.

[1] Trade mark registered in the U. S. Patent Office by Continental-Diamond Fibre Corp.

* Continental-Diamond Fibre Co., Newark, Del.

Sheets, rods and fabricated parts including terminal boards, instrument bases, coil forms, insulating washers, lead-in spacer and chemical-plant parts of Dilectene

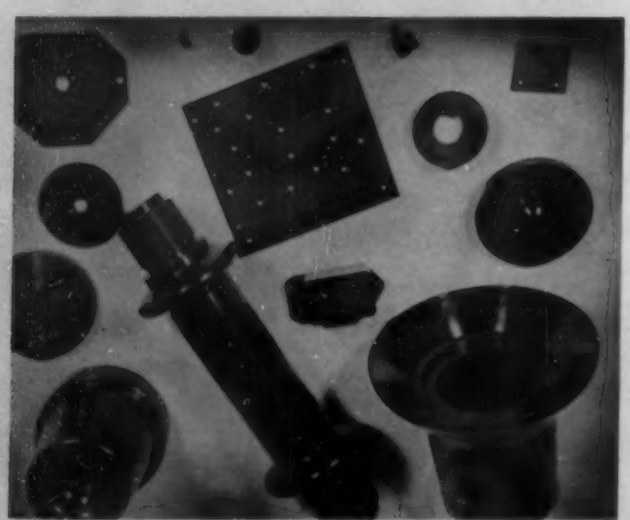


TABLE I—PROPERTIES OF DILECTENE (1/8 IN. SHEET)

	Dilectene 100	*Dilectene 160*
Specific gravity	1.21	1.31
Hardness, Rockwell		
Room temperature	M-100–125	M-110–115
90 deg. C.	M-105–115	Too soft
Hardness, scleroscope	85–95	83–90
Water absorption, 3 in. by 1 in. specimen (A.S.T.M. D570–40T)		
24 hours, percent	.08	.03
144 hours, percent	.21	.06
Tensile strength, p.s.i.	10,500	9,000
Flexural strength, p.s.i.	20,000	16,000
Modulus of elasticity in flexure, p.s.i.	740,000	1,800,000
Compression strength, flatwise, p.s.i.	20,000	20,000
Impact strength, Izod, 1/2 in. by 1/2 in. specimen, parallel to molding pressure, ft. lb. per inch of notch	.33	.38
Cold flow (A.S.T.M. D621–41T) 1/2 in. by 1/2 in. by 3/8 in. pileup, percent reduction in height after 24 hours	.17	16.35
Dielectric strength, volts per mil		
Short time,		
80 deg. F.	640	470
100 deg. F.	600	570
150 deg. F.	720	550
Step by step,		
80 deg. F.	410	430
100 deg. F.	520	490
150 deg. F.	650	480
Insulation resistance, megohms, after 4 days at 90 percent RH, 95 deg. F.	96,000 (Unaffected by continued exposure)	62,000 (Decreased by continued exposure)
Distortion point (A.S.T.M. D48–39) (10 mil deflection under 5-lb. load), deg. F.	210	125
Coefficient of linear thermal expansion (specimen 18 in. long by 3 in. wide by 3/8 in. thick), parts per million per deg. F.	30	See Fig. 6

In consequence, it is highly resistant to moisture and electrically very stable. It is also made in a plasticized grade known as Dilectene 160.

In general, this new material will fit into the picture now occupied by hard rubber, polystyrene, phenolic laminates, mica-resin or mica with inorganic binder combinations, and certain ceramics. Each of these materials has its definite uses and advantages and all of them are valuable insulating materials, but no one of them is completely ideal. In comparison with each, the aniline-formaldehyde resin has its advantages and, it must be admitted, its disadvantages. This is, of course, to be expected, but the interesting feature in this case is the number of ways in which this resin is found to possess such a combination of properties as to make it particularly useful not only in these fields of application, but also in many places where these materials will not be satisfactory. Thus, hard rubber and the phenolic laminates are adversely affected by ultraviolet light and by weather conditions; aniline-formaldehyde resin is not. The ceramics and the bonded mica combinations are extremely difficult to machine and are inclined to be brittle. Polystyrene is difficult to work when unplasticized due to its inherent toughness, while the plasticized grade has relatively poor electrical insulating properties, particularly at higher frequencies, and a strong tendency to cold flow. In comparison, both Dilectene 100 and Dilectene 160 can with proper care be machined in almost every way; the electrical properties are very little affected by plasticization and the cold flow of the unplasticized grade is very slight indeed, while that of the plasticized material is not excessive. However, as can be seen from the accompanying data, these materials are somewhat affected by moderately high temperatures.

Summing up then, this aniline-formaldehyde resin has a few defects which are considerably outweighed by its advantages. It is sensitive (particularly Dilectene 160), both mechanically and electrically, to moderately high temperatures, as can be expected for any organic material. Also, some special care must be taken in machining the material. On the other hand, it has a low power factor, dielectric constant and loss factor, all of which are remarkably stable over an extremely wide range of frequencies and in the face of the most adverse moisture conditions. Its high insulation resistance is not appreciably affected by weathering, although this too is not so true of the plasticized grade. The dielectric strength is high. Its mechanical strength is good. The cold flow and tendency to warp is very slight; even that of Dilectene 160 is fairly low.

The chemical stability of this resin is very good. Although it is attacked by strong acids, it is unaffected by alkalies and is not soluble in any of the common organic solvents. Especially noteworthy is its resistance to benzene-type hydrocarbons and to alcohols, which will affect many other materials.

The properties of both Dilectene 100 and Dilectene 160 are presented in Tables I to IV, inclusive. Some of these data are also plotted in Figs. 1 to 6, inclusive. The greater part of the data shown in Tables I to IV was obtained on sheet stock, which is the form in which this aniline-formaldehyde is ordinarily used. In addition, molded rods are available.

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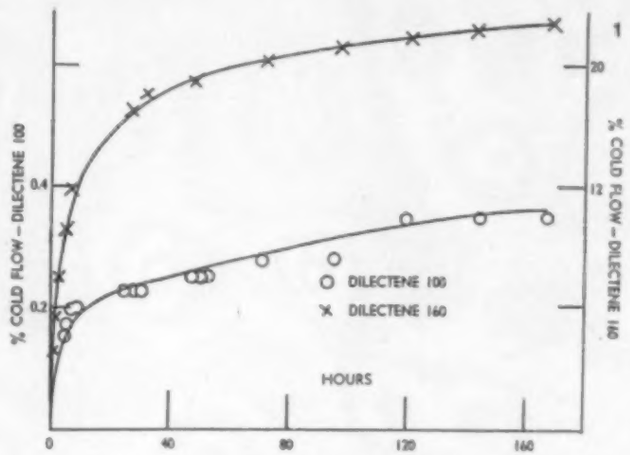
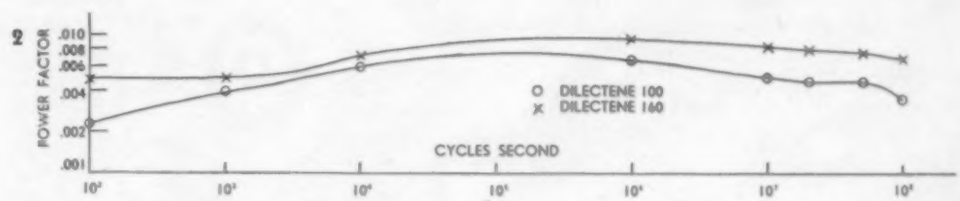
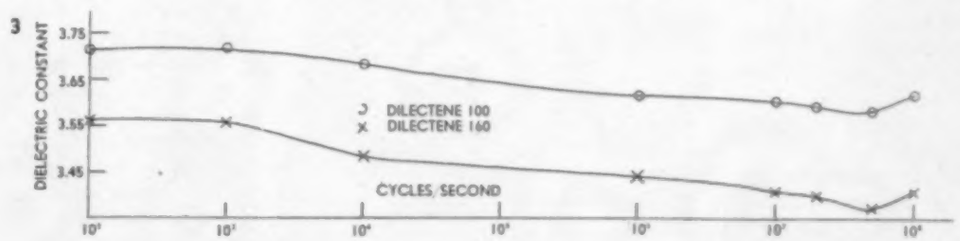
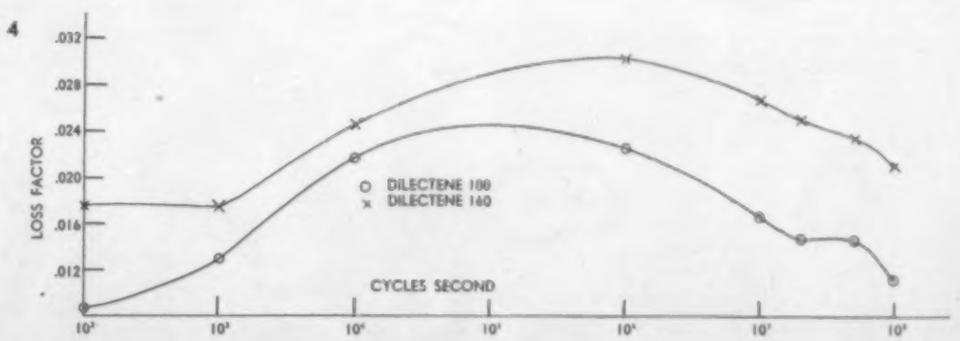








These charts graph the variation of certain properties of this aniline-formaldehyde synthetic resin: **1***—Cold flow vs. time.* **2***—Power factor vs. frequency.* **3***—Dielectric constant vs. frequency.* **4***—Loss factor vs. frequency*

TABLE II—VARIATION OF LOSS PROPERTIES OF DILECTENE WITH FREQUENCY

Frequency	*Power Factor*	*Dielectric Constant*	*Loss Factor*
		Dilectene 100	
100 C	.00226	3.72	.0084
1 KC	.00351	3.72	.0130
10 KC	.00595	3.68	.0219
1 MC	.00624	3.62	.0226
10 MC	.00469	3.60	.0169
20 MC	.00420	3.59	.0151
50 MC	.00425	3.58	.0152
100 MC	.00318	3.62	.0115
		Dilectene 160	
100 C	.00495	3.56	.0176
1 KC	.00497	3.56	.0177
10 KC	.00703	3.48	.0244
1 MC	.00881	3.43	.0302
10 MC	.00778	3.41	.0266
20 MC	.00737	3.40	.0251
50 MC	.00702	3.37	.0236
100 MC	.00641	3.41	.0218

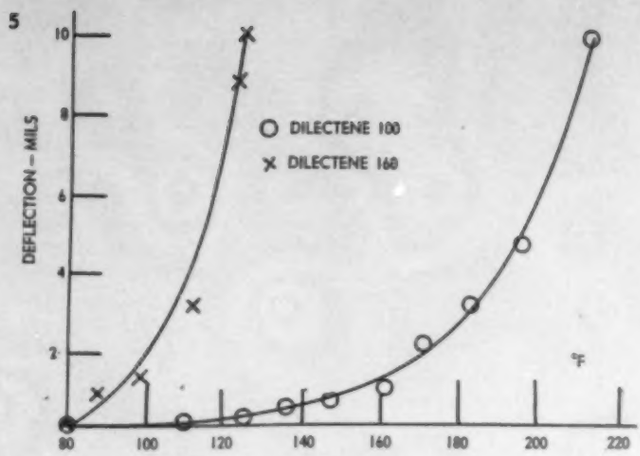
TABLE III—VARIATION OF LOSS PROPERTIES OF DILECTENE 100 UPON IMMERSION IN WATER AT ROOM TEMPERATURE (MEASUREMENTS MADE AT 10^6 CYCLES)

Time Immersed	*Power Factor*	*Dielectric Constant*	*Loss Factor*
0	.00650	3.66	.0237
24 hours	.00680	3.73	.0250
48 hours	.00700	3.77	.0263
72 hours	.00693	3.67	.0253
96 hours	.00664	3.73	.0248
1 week	.00683	3.70	.0253
2 weeks	.00713	3.81	.0271
3 weeks	.00845	3.83	.0324

TABLE IV—CHEMICAL STABILITY OF DILECTENE

Solvent or Reagent	*Dilectene 100*	*Dilectene 160*
Toluene	Not attacked	Plasticizer attacked
Benzene	" "	" "
Alcohol	" "	Not attacked
Acetone	" "	" "
Gasoline	" "	Plasticizer attacked
Epichlorhydrin	Attacked	Attacked
Dichlorhydrin	"	"
Amines (some)	"	"
Aniline	"	"
Weak acids	Slight attack	
Strong acids	Strong attack	
Hydrochloric acid, 1%	Attacked	
Sulfuric acid, 1%	"	
Hydrochloric acid, conc.	"	
Sulfuric acid, conc.	"	
Acetic acid, 1%	Not attacked	
Acetic acid, conc.	Attacked	
Formic acid	Strong attack	
Sodium hydroxide, up to 25%	Not attacked	
Ammonium hydroxide (27–29%)	No attack (absorption equal to that of H_2O)	
Effect of age	None	None
Effect of light	None	None
Burning	Will not support combustion	

5



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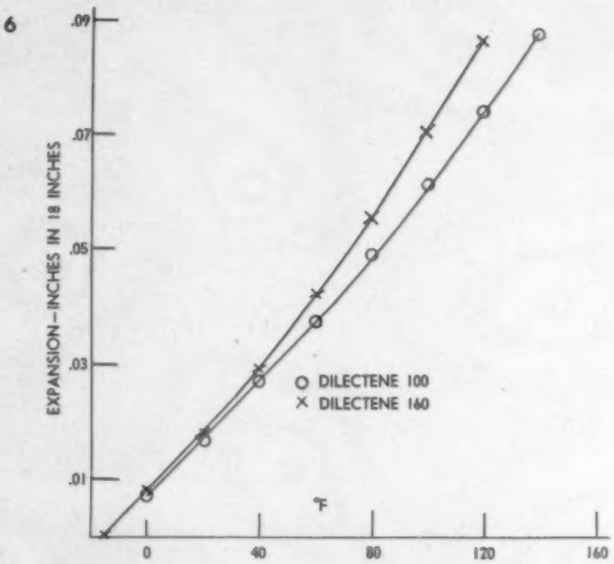

5—Heat distortion (A.S.T.M.) vs. temperature.

6—Linear expansion vs. temperature

This resin can be worked with standard tools and methods, provided both the tool and the material to be machined are kept cool. It can be sawed, drilled, tapped, turned, milled, formed in a mold, ground, polished and threaded. In all cases, the tools should be kept sharp and should preferably operate at high speed. By these methods, it is possible to produce almost any desired piece according to the application for which it is intended.

The properties of the aniline-formaldehyde resin are thus of such a nature as to indicate its use for many varied applications. Its low loss properties and exceptional electrical stability under the influence of moisture and at ultra-high as well as at commercial frequencies suit it for applications in the radio field and in the expanding television industry. It is of special interest for aircraft work. Such particular applications as coil forms, jack pile-ups, antenna housings and tube bases are important. Because of its low power factor and its great stability, it is suitable for stator insulation. Terminal boards, strips and blocks are other applications for which the material is especially suitable, in this case because of its high insulation resistance, and the maintenance of this insulation resistance in the presence of moisture. Outside applications, such as stand-off insulators and antenna lead-in spacer insulators, are possible with the resin. It can also be used in test equipment where the stability of the insulating material is of the utmost importance. These are only a few of the applications possible, but this sample listing will indicate the general utility of the material.

Surface irregularities of clear plastics*

Scope

1. (*a*) This method of test is intended for the measurement of the surface irregularities of flat transparent plastic sheets that are ordinarily used to cover openings through which visual and instrumental observations are made.

(*b*) This method measures the distortion and the deviation of line of sight through flat sheets of transparent plastics. The method makes use of the prismatic or optical wedge deflection of a beam of light as it passes through a distortion spot or wave in the body of or on the surface of the material being inspected.

Description of terms

2. (*a*) *Displacement factor.* Displacement factor is the maximum movement (in inches) of the image of the cross, divided by the distance (in feet) from the projector to the screen, multiplied by 1000.

(*b*) *Frequency of image movement.* Frequency of image movement shall be described as (*1*) irregular or wavy, (*2*) frequent or (*3*) single shift.

(*c*) *Pattern distance.* Pattern distance is the maximum distance (in integer multiples of 5 in.) from the screen at which the specimen can be held without producing a sharply defined pattern of its minor surface irregularities.

Apparatus

3. The apparatus shall consist of the following:

(*a*) *Projector.* A good quality lantern slide projector or similar assembly of light source and lenses that is capable of producing a sharply defined image on a screen at a distance of 25 ft. The objective lens of this system shall have an aperture approximately 2 in. in diameter and a focal length of approximately 12 in.

(*b*) *Slide.* A transparent slide on which have been ruled two very fine black lines crossing at right angles at the center of the slide. This slide may be prepared by photographing a drawing or by directly ruling fine lines on some suitable transparent medium.

(*c*) *Screen.* A square white screen measuring about 5 ft. on a side. This screen shall have a symmetrical cross ruled on it consisting of seven horizontal parallel fine lines spaced 0.5 in. apart and seven vertical parallel fine lines spaced 0.5 in. apart. These lines shall be as fine as it is possible to make them and still have them distinctly visible at a distance of 25 ft. A width of about $^1/_{16}$ in. is suggested.

NOTE. An alternative form of target may be preferred, consisting of concentric circles having radii increasing by 1 in. from a 1-in. radius for the innermost circle, ruled in the center of a piece of white cardboard 1 ft. square. It is suggested that the first circle be ruled with a line thickness of $^1/_8$ in., the second with a line thickness of $^1/_{16}$ in., the third with a line thickness of $^1/_8$ in., and so on.

(*d*) *Supports.* A suitable means of rigidly supporting the projector and the screen.

(*e*) *Dark room.* A slightly darkened or dark room of sufficient length to accommodate the test set-up. It has been found that an illumination level of not over 10 foot candles in the room will be satisfactorily dark when an ordinary lantern slide projector is being used.

Assembly of apparatus

4. (*a*) The screen shall be placed 25 ft. from the front lens of the projector and perpendicular to the direction of projection.

(*b*) The cross-ruled slide shall be placed in the projector and the projector and its lens system adjusted to throw a sharply defined image of the cross directly on top of the center cross ruled on the screen.

NOTE. If the alternate form of target is used, the projector shall be adjusted so that the center of the image of the cross falls on the center of the circles.

Test specimen

5. The test specimen shall consist of any flat sheet of a transparent plastic.

Procedure

6. (*a*) The test specimen shall be held with its plane perpendicular to the direction of projection and in front of the projector at a distance of approximately 12 in. from the front lens and shall be moved so that the entire area inside of a 1-in. border around the sheet is surveyed by the beam of light from the projector system. While the specimen is being moved about, the screen shall be observed for movement of the projected image of the cross. The maximum amount and nature or frequency of movement of the image shall be noted.

(*b*) After the specimen has been completely surveyed in the position near the projector, it shall be moved parallel to and at a distance of 5 in. from the screen. The specimen shall then be moved back and forth parallel to the screen and any projected images of minor irregularities that are visible on the screen shall be observed. The specimen shall then be moved to positions 10 in., 15 in. or 20 in. (integer multiples of 5 in.) from the screen until a pattern is observed. The maximum distance from the screen at which the specimen can be held without producing a pattern of its minor surface irregularities shall be noted.

Report

7. The report shall include the following:

(1) The displacement factor,
(2) The frequency and nature of the shift of the image, and
(3) The pattern distance in an integer multiple of 5 in.

* This tentative method of test for surface irregularities of flat transparent plastic sheet, A.S.T.M. designation D 637–41 T, is published here by permission of the American Society for Testing Materials.

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Technical briefs

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments

Engineering

CHEMICAL ASPECTS OF THE CRANBERRY INDUSTRY. Ralph K. Carleton and Walter A. Nealy. Rept. New Engl. Assoc. Chem. Teachers *43*, 84–8 (1942). A plastic suitable as a substitute for cork is one of the by-products of the cranberry industry.

WOOD HYDROLYSIS. A CONTINUOUS PROCESS. Raphael Katzen and Donald F. Othmer. Ind. Eng. Chem. *34*, 314 (Mar. 1942). A continuous hydrolysis process for making lignocelluloses from wood is described. The lignocelluloses which can be made with various properties, are useful as semi-plastic fillers for thermoplastics.

SYNTHETIC RESINS IN THE PAPER INDUSTRY. H. Liander. Svensk. Papperstidn. *44*, 481–5 (1941). A review of synthetic resins of technical interest in the paper industry. The use of phenolic resins in papermaking is discussed. Urea-formaldehyde and melamine-formaldehyde resins increase the wet strength of paper. More work, particularly on a larger scale, is advocated to evaluate the technical and economical aspects of the use of synthetic resins in papermaking.

Chemistry

RELATION BETWEEN VISCOSITY OF SOLUTIONS AND PHYSICAL PROPERTIES OF HIGH POLYMERS. Robert Simha. J. Applied Phys. *13*, 147–53 (Mar. 1942). What can be said about the size and shape of the molecules of a high molecular weight polymer on the basis of the change in viscosity of a solvent, brought about by dissolving the high polymer in it? A quantitative treatment is developed on the basis of the hydrodynamic method and applied to proteins, cellulose triacetate, polyvinyl acetate, methyl methacrylate polymer, polystyrene and methylcellulose. It seems possible to formulate quantitative relations between shape factors of the solute molecule and viscosity increment, in a linear concentration range, as long as appreciable orientation effects are absent. This can be done in ascribing to the molecule an effective shape corresponding to an ellipsoid, or to an array of spheres, which cannot change shape to any considerable extent while moving in the viscosimeter. In these cases, it is possible to undertake a comparison with sedimentation data. Orientation due to shear as well as flexibility tends to decrease the viscosity, the latter factor presumably to a lesser degree. It is possible on this basis to interpret the Staudinger rule and deviations therefrom, and to derive correlations between molecular weight and shape from experiment. Because of imperfections of the theory and the scarcity of sufficiently accurate data, in the results found independently there are discrepancies which await further elucidation.

EFFECTS OF HEAT, SOLVENTS AND HYDROGEN - BONDING AGENTS ON THE CRYSTALLINITY OF CELLULOSE ESTERS. W. O. Baker, C. S. Fuller and N. R. Pape. J. A. C. S. *64*, 776–82 (Apr. 1942). See abstract of this article on page 81 of Oct. 1941 issue of MODERN PLASTICS.

INVESTIGATION OF THE PROPERTIES AND CONDITIONS FOR PRODUCING NOVOLAC MASSES. A. D. Sokolov, S. I. Kirillova and A. V. Kupfer. Plasticheskie Massy, Sbornik Statel *1939*, 191–203. A study of the reactions of formaldehyde with phenol. RESINS AND MOLDING POWDERS FROM UREA AND FORMALDEHYDE A. A. Vansheldt and Z. K. Naumova. Ibid. *1939*, 216–48. A study of the condensation reactions of formaldehyde with urea and thiourea. PRODUCTION OF COLORLESS RESINS FROM PHENOL AND FORMALDEHYDE. A. A. Vansheldt and O. N. Simonova. Ibid. *1939*, 129–40. A study of the conditions and catalysts in the production of nearly colorless phenolic resins. For longer abstracts of these articles, see Chem. Abstracts *36*, 2343–46 (April 20, 1942).

Coatings

SOIL-CORROSION STUDIES 1939. COATINGS FOR THE PROTECTION OF METALS UNDERGROUND. Kirk H. Logan. J. Research Nat. Bur. Standards *28*, 57–71 (Jan. 1942). Twenty coating materials were applied to steel pipe and buried in several types of soils for two to sixteen years. Of the non-metallic coatings, two rubber coatings, a vitreous enamel and a baked phenolic varnish offered the best protection against corrosion.

VISCOSITY OF NITROCELLULOSE SOLUTIONS. Giancarlo Guainazzi. Paint Ind. Mag. *56*, 377 (1941). The molecular weight ratio of two solvents in a series is approximately equal to the viscosity ratio of the nitrocellulose solutions. Solvents containing the same number of hydroxyl groups and with the same molecular weight form solutions of equal viscosity with nitrocellulose. Alcohols are not solvents but thinners. The relation between viscosity of nitrocellulose solutions and the molecular weight of the solvents is independent of the chemical nature of the solvent within similar series. The relation is practically the same for ketones and aliphatic esters but is altered by introducing a hydroxyl group into the solvent molecule.

ORGANIC SOLVENTS. Willard Seeman. Ind. Finishing *18*, No. 1, 30, 32, 37, 38 (1941). A review of organic solvents employed in organic finishing materials.

SOLVENTS FOR NITROCELLULOSE. A. Kraus. Farben-Ztg. *46*, 190, 382–3, 400–1 (1941). The solvent power of carbon disulfide, nitro compounds, organic acids and alcohols for nitrocellulose are reported.

THE PHENOMENON OF SWELLING OF ACRYLIC RESIN FILMS. III. O. E. Hintze. Fette und Seifen *48*, 62–82 (1941). Chem. Abstracts, *36*, 1200 (1942). Data on about 35 commercial protective coating vehicles and 70 commercial pigments in concentrations of 2.5 to 88.9 percent are tabulated. The data are useful for compounding coatings and their selection for specific uses.

Properties

ON THE PROPAGATION OF SHATTERING IN GLASS AND IN GLASS SUBSTITUTES. H. Schardin, D. Elle and W. Struth. Z. Techn. Phys. *21*, 393–400 (1940). A study of the propagation of shattering processes in transparent bodies was made by means of spark cinematography. Shots were fired obliquely through the glass or perpendicularly to an edge. The results agree with those reported by Barstow and Edgerton (J. Amer. Ceram. Soc. *22*, 302, 1939) obtained by striking the glass with a body having low velocity. Elastic strain developed by the shots was studied by means of polarized light and color photography. With both oblique and edgewise shots, longitudinal waves of velocity 5400 m./sec. were present, accompanied by the shattering process traveling at 1500 m./sec. Secondary shattering occurred as the result of cooperation of longitudinal and transverse waves and the existence of some irregularity initiating a break before the arrival of primary shattering. Such secondary shattering occurred especially at the edges of plates, at the location of wires in wire-embedded glass or at natural or artificial interruptions of the glass surface. Shatter velocity along lines ruled with a diamond was about double that of the normal. This is easily explained as a continuous cooperation of primary and secondary processes. Numerous photographs show many stages of shattering in glass, laminated glass and Plexiglas.

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INDICATOR UNITS FOR AIRPLANES are sealed in Tenite for safe delivery to assembly points. These Tenite containers protect the units against dust accumulation, corrosive elements, and shipping damages—assuring the recipient of a factory-perfect product. Transparent Tenite is used for purposes of instant identification of the contents.

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Plastics digest

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals mentioned directly to individual publishers

General

STANDARDIZATION AND PLASTICS. W. Cornheli. Plastics *6*, 112–3 (Apr. 1942). A plea for post-war preparation by standardization of materials and products for which the reconstruction period will create big demands.

SUBSTITUTES FOR SILK AND RUBBER. E. Engel and J. Steel. Aero Digest *40*, 212, 214 (May 1942). "V" plastics of the Colonial Alloys Co. are made in various types and forms to meet specific aircraft needs. Tubing, sheets or strips can be used for gaskets, lining self-sealing fuel tanks, water and oil lubricating lines, and various electrical insulating jobs. Multi-filaments in the form of fabrics, cords and cables may serve as parachutes, barrage balloon coverings, shroud lines and tapes.

PLASTICS AND THE TIME FACTOR. H. Leaderman. Am. Dyestuff Rept. *31*, 227–30, 246–8 (May 11, 1942). Plastics manifest in their mechanical properties a marked "time-effect." This can be demonstrated by creep tests under constant load and creep recovery following removal of load. Under certain conditions this creep and creep recovery can be considered as a "delayed elasticity." The Superposition Principle of Boltzmann accounts quantitatively for this phenomenon in materials such as glass and at least qualitatively for the well-known "memory-effect" in rubber and other high polymeric plastics.

Materials and Manufacture

VINYLIDENE CHLORIDE POLYMERS. W. C. Goggin and R. D. Lowry. Ind. and Eng. Chem. *34*, 327–32 (Feb. 1942). See abstract of this article on page 81 in the Oct. 1941 issue of MODERN PLASTICS.

PLASTIC MASSES FROM POLYSTYRENE. N. P. Bogoroditskiĭ and I. D. Fridberg. Plasticheskie Massy, Sbornik Statei *1939*, 260–74. Powdered marble was used as a filler to increase the heat stability and mechanical strength and to reduce the cost of polystyrene. The powdered marble was saturated (1) by a solution of polystyrene in aromatic solvents and (2) by monomeric styrene subsequently polymerized. After mastication, products possessing poor moisture resistance were produced and the dielectric properties were markedly affected by immersion in water for 24 hours. Milling at 120–130 deg. C., followed by grinding and molding, produced more water-resistant objects. On immersing such a mass, consisting of equal parts of marble and polystyrene, in water for 48 hrs., the loss angle increased from 2.5 ft. to 4 ft., the dielectric permeability remained at 4.38, and the specific volume resistance decreased from 1×10^{16} to 6×10^{15}.

THERMAL SETTING OF PHENOLIC RESINS. C. A. Redfarn. Brit. Plastics *13*, 481–2 (Apr. 1942). According to a current theory a phenol should have the two ortho and the para positions free in order to give a thermosetting resin with formaldehyde. The 4-chlor-1,3,5-xylenol gives a rapidly thermal-setting resin, but the chlorine may be considered to activate the phenolic hydroxyl. However, it was observed that 1-hydroxy-3,4,5-trimethylbenzene (sym. hemimellitenol) also forms an infusible resin rapidly when reacted with formaldehyde. Cross-linking must take place through reaction of the phenolic hydroxyl, a hypothesis originally put forward by Baekeland.

SYNTHETIC RESINS AND SYNTHETIC RUBBERS. P. O. Powers. Chem. and Eng. News *20*, 536–8 (Apr. 25, 1942). A chart showing raw materials, structural formulas and trade names of commercial plastics.

PRODUCING A RUBBER-LIKE SYNTHETIC. Chem. and Met. Eng. *49*, 80–1 (Apr. 1942). A description of the plant manufacture of polyvinyl alcohol.

Applications

LIGHT SENSITIVE PLASTICS IN PHOTO-ENGRAVING. P. C. Smethurst. Plastics *6*, 108–11 (Apr. 1942). The basic principles underlying all present photo-engraving processes are described briefly. Research on the use of water-soluble resins for this purpose is discussed.

CORRECT METHODS OF PLEXIGLAS INSTALLATION. D. S. Frederick. Aviation *1942*, 62–8 (Apr.). Methyl methacrylate resin has proved its permanence under severe weather conditions provided it is properly installed. Good practice in designing holding frames and selecting sizes and thicknesses of panels is set forth. A maximum stress of 900 to 1000 lb. per sq. in. is recommended, based on the results obtained by an accelerated crazing which is described in detail.

PROPERTIES AND USES OF RESISTOFLEX. W. Mac William. Aero Digest *40*, 229, 260 (May 1942). This plastic is considered to be an adequate replacement for hose lined with synthetic rubber and, as an added advantage, is impervious to the benzol-blend fuels used in the Far East.

PLASTIC BUILDING COMPONENTS. G. Féjer. Plastics *6*, 90–7 (Apr. 1942). An architect's conception of the place of plastics in certain building structures. Details of well-established non-plastic products are given.

Design

INDUSTRIAL PLASTIC PARTS. T. N. Willcox. Product Eng. *13*, 269–71 (May 1942). General design considerations for hot- and cold-molded plastics are reviewed. Minimum hole diameters and side wall thicknesses and maximum hole lengths are tabulated. Tolerances for molded plastics in a direction perpendicular to the applied pressure are given as follows:

Nominal Dimensions, In.	Tolerances, ± In. Hot-Molded	Cold-Molded
0.5 or less	.002	.010
0.005 to 2.000	.005	.013
2.000 or over	.0025 per in.	.010 and .003 per in.

In hot compression molding 0.005 to 0.020-in. build-up can be expected in the direction of molding; in transfer and injection molding this can be held to less than 0.005 in. For closer tolerances resort must be had to final machining to size.

Adhesives

CHEMICAL FACTORS INVOLVED IN THE GLUING OF WOOD WITH COLD-SETTING UREA-FORMALDEHYDE RESINS. W. G. Campbell. Chem. and Ind *61*, 161–2 (Apr. 4, 1942). Birch and beech woods underwent considerable deterioration in strength after twelve months at 25 deg. C. at pH values substantially below 3. At pH values above 3.5 the extent of deterioration in the same wood was not great. Accelerated tests at 80 deg. C. for two days differentiated between corrosive and relatively non-corrosive glues. Tests on the strength decline at any given pH over a period of a year indicated at very low pH a rapid decline at first, whereas at higher pH values the decline took place at a relatively slow but fairly uniform rate. Cracking and crazing of thick glue films was attributed to the unbalanced stresses arising during the dehydration which accompanied setting unless special precautions were taken.

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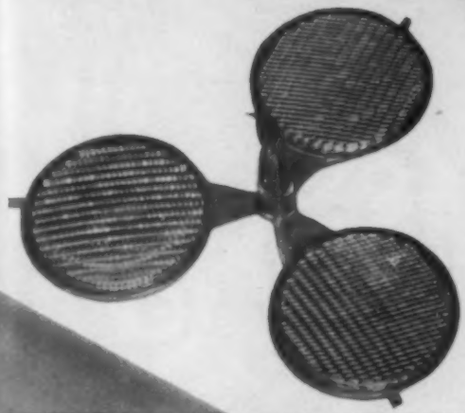

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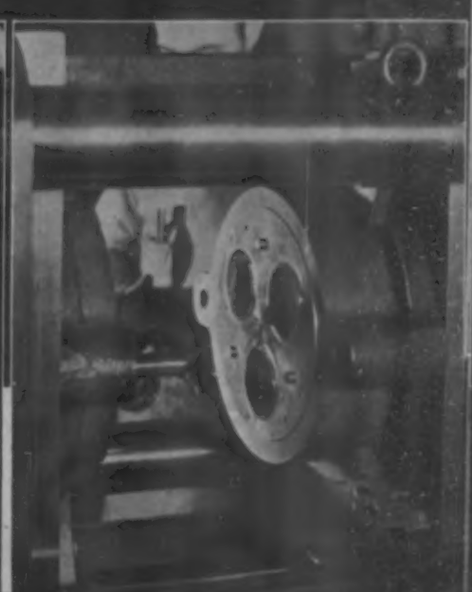

(Above) 200-HX-12 H-P-M Plastic Injection Molding Press with maximum injection capacity of 12 ozs. per press cycle.

(Lower Left) Gates and sprue are removed by a band saw while press is making the next molding cycle.

(Lower Right) Three cavity mold illustrates the precision die work required to mold highly finished parts.

U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

FABRIC. R. E. Reed (to Kendall Co.). U. S. 2,277,049, March 24. Coalescing thermoplastic fibers with other fibers in a textile fabric by heat.

INFUSER. R. E. Reed and J. F. Ryan (to Kendall Co.). U. S. 2,277,050, March 24. A porous envelope for a substance to be infused in a liquid is formed of unspun textile fibers mixed with thermoplastic binder fibers capable of coalescing when heated.

VINYL RESIN. G. L. Dorough (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,277,083, March 24. Heating a hydroxylated vinyl resin with 10 percent or less of an aliphatic diisocyanate.

POLYAMIDES. E. L. Martin (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,277,125, March 24. Heating a bifunctional amide-forming reactant containing at least one formylamino group, to form polyamides.

LINEAR POLYAMIDES. P. Schlack (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,277,152, March 24. Heating N-acylated amino acids or their esters, lactams, chlorides or amides to form polyamides.

VINYL PLASTICS. E. Schnabel and C. Dangelmajer (to Resistoflex Corp.). U. S. 2,277,259, March 24. A solid plasticized polyvinyl alcohol preparation for making shaped articles.

THIOAMMELINE RESIN. H. A. Bruson (to Resinous Products and Chemical Co.). U. S. 2,277,267, March 24. Making a resin from a thioammeline ketoether.

SHEET MATERIAL. A. O. Beckman, Wm. A. Bush and Harry Rubin. U. S. 2,277,287, March 24. Impregnating a fibrous web first with a rosin solution in a nonvolatile oil, then with a blend of a resin and ethyl cellulose.

DIFFUSER. Edwin F. Guth. U. S. 2,277,433, March 24. A translucent plastic diffuser for attachment to tubular lamps.

ALDEHYDE RESINS. G. F. D'Alelio (to General Electric Co.). U. S. 2,277,479–80, March 24. Condensing acetoacetic ester with formaldehyde in presence of morpholine as a catalyst; and condensing urea with formaldehyde and chloroacetaldehyde.

FLASH LAMP. M. J. Neumann de Margitta (to Westinghouse Electric and Mfg. Co.). U. S. 2,277,481–2, March 24. A flash lamp shell containing a metal flash powder and active gas is closed by a dished base of cellulose acetate; and dished sections of transparent plastic are joined by a pressure-resisting seal to form a compartment for flash powder.

VINYLIDENE RESINS. R. M. Wiley (to Dow Chemical Co.). U. S. 2,277,504, March 24. Freeing vinylidene chloride high polymers (or interpolymers with vinyl chloride or the like) from low polymers and catalyst residues by acid and solvent extraction.

MICA RINGS. L. L. Howard (to Continental Diamond Fibre Co.). U. S. 2,277,590, March 24. Hot-press molding of rings formed of mica flakes and a moldable binder.

BOTTLE CAPS. A. B. McGinnis (to Wheeling Stamping Co.). U. S. 2,277,599, March 24. Apparatus for molding internally threaded closure caps from plastic compositions.

CLUTCH FACING. I. J. Novak (to Raybestos-Manhattan Inc.). U. S. 2,277,602, March 24. Winding endless clutch facings from a fibrous strand, impregnating the strand with a binder and molding under heat and pressure.

INSERTS IN MOLDINGS. L. T. Barnette (to Standard Products Co.). U. S. 2,277,673, March 31. In molding plastics around T-shaped inserts stiff supporting rods project from the lower section of the divided mold into the mold cavity to prevent bending of the inserts under the pressure of the injected plastic.

RESILIENT TEXTILES. H. Dreyfus (to Celanese Corp. of America). U. S. 2,277,747, March 31. Leaching out soluble matter from cellulose derivative filaments or tapes, and impregnating with a resinifiable composition in the same bath, then completing the resinification process to form a waterproof resin in the filaments or tapes.

CRIMPING RESIN FIBEkS. E. W. Rugeley (to Carbide and Carbon Chemicals Corp.). U. S. 2,277,782, March 31. Incorporating vinyl resin fibers in a fabric, then releasing their internal stresses to shrink and crimp the resin fibers.

SHOE STIFFENERS. R. Almy (to Armstrong Cork Co.). U. S. 2,277,941, March 31. Shoe stiffener blanks containing a partially condensed aldehyde resin are wetted with an activator solution, incorporated in a shoe upper and heated to set the resin.

SULFIDE PLASTIC. J. C. Patrick (to Thiokol Corp.). U. S. 2,278,127–8, March 31. Incorporating a butadiene polymer in a sulfurized olefin plastic; and treating a sulfurized olefin plastic with a desulfurizing agent.

MOLD PRESS. W. H. Osborn (to Phelps Dodge Corp.). U. S. 2,278,135, March 31. A mold press having a plunger surrounded by a mold head which is movable with respect to the plunger.

CAN END. Albin H. Warth. U. S. 2,278,141, March 31. A sealing composition for cans comprises Vistanex resin and a softer polymerized olefin resin.

PANEL BOARD. W. J. Moeller (to Philip Carey Mfg. Co.). U. S. 2,278,146, March 31. In composite panel board the fibrous layers are joined by a hard thermoplastic adhesive.

SPUN GLASS. K. N. Mathes (to General Electric Co.). U. S. 2,278,207, March 31. Coating glass fibers with aluminum stearate and isobutene resin to form flexible nontacky products with high tearing strength and abrasion resistance.

PLASTICIZED VINYL CHLORIDE. J. G. E. Wright (to General Electric Co.). U. S. 2,278,231, March 31. Making filaments or sheets of plasticized polyvinyl chloride containing tetraethyl silicate, by coagulation with water.

MATRIX. H. Swan and S. Higgins (to Bakelite Corp.). U. S. 2,278,291, March 31. Compression molding of a matrix from sheeted pulp of long and short fibers impregnated with a thermosetting resin.

GRINDING WHEEL. H. E. Bauer (to Abrasive Co.). U. S. 2,278,301, March 31. A molded cup-shaped grinding wheel mounted on a core having supporting disks embedded in the wheel.

(Please turn to page 82)

Versatility

The ability to mold for a lot of industries . . . . and do it well . . . . the ability to mold in all plastics . . . . and handle each as it should be done . . . . the ability to build the molds to the highest degree of precision irrespective of how complicated the design . . . . the ability (and the equipment) to mold by both the injection and compression process: these are concrete examples of versatility in plastics manufacture which are important to every buyer. Tech-Art offer this versatile service to men and businesses interested in production and/or development. We offer—as our name indicates—both technical and artistic service, from the creation of design, through blueprinting and mold-making, through molding, through assembly and finishing. Let Tech-Art go to work on your plastics problem.

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FILMS ON METAL. D. G. Benson (to B. F. Goodrich Co.). U. S. 2,278,345, March 31. Facing metal tanks first with fabric cemented in place with waterglass, and finally with a protective film of polyvinyl chloride in several coats.

INSULATED WIRE. G. D. Graves (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,278,350, March 31. Coating wire conductors with a composition of a polyamide resin and a polycyclic amine.

POLYSULFIDE PLASTIC. W. Frost (to Silesia Verein Chemischer Fabriken). U. S. 2,278,368, March 31. Condensing ethylene dichloride with an inorganic polysulfide in presence of pentabromopentane or a chloroparaffin.

SAFETY GLASS. F. W. Hall (to Pittsburgh Plate Glass Co.). U. S. 2,278,369, March 31. Laminated glass with 3 glass sheets and 2 plastic interlayers has one glass sheet narrower than the other two to form a margin for mounting the laminated plate in a wall.

UREA RESINS. J. F. Olin (to Sharples Chemicals, Inc.). U. S. 2,278,374–5, March 31. Condensing formaldehyde with cyclohexylurea and sufficient urea to harden the resulting resin; and condensing formaldehyde with an alkylurea (butyl- to dodecylurea) and enough urea to impart high viscosity to the resulting liquid resin.

CELLULOSE ETHER. D. C. Ellsworth and F. C. Hahn (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,278,389, March 31. Making low-substituted alkylcelluloses which are soluble in dilute alkali in the cold but not at room temperature.

VINYLIDENE CHLORIDE RESINS. H. W. Arnold (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,278,415, April 7. Interpolymerizing vinylidene chloride with a methacrylate ester, styrene, acrylonitrile or the like.

ANTIHALATION LAYER. M. Marasco (to Du Pont Film Mfg. Corp.). U. S. 2,278,457, April 7. Photographic film is faced on one side with the emulsion and on the other side with an antihalation layer of dyed gelatin or glue, protected by a film of alkali-soluble resin.

PROTECTIVE COATING. D. L. Gibb and A. B. Savage (to Dow Chemical Co.). U. S. 2,278,515, April 7. Coating a surface first with plasticized low viscosity ethylcellulose and then with a film of high viscosity ethylcellulose.

LENSES. C. E. Barnes (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,278,528, April 7. Forming accurately shaped lenses from interpolymers of methyl methacrylate with vinyl formate.

MOISTURE-PROOF CONTAINERS. K. Bratring (to Neocell Products Corp.). U. S. 2,278,609, April 7. Seamless cylindrical containers formed from layers of cellulosic material joined by a film of moistureproofing adhesive.

ACRYLATE AND KETONE RESINS. C. E. Barnes (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,278,634–5–6–7–8, April 7. Resinous polymers of biphenyl acrylate or methacrylate; transparent resins for lenses made by interpolymerizing methyl methacrylate with divinyl or diisopropenyl ketone; interpolymers of acrylic or methacrylic anhydride, the ethylideneglycol ester of one of these acids and a vinyl compound; interpolymers of methyl or methacrylic anhydride, allyl or methallyl acrylate or methacrylate and a vinyl compound; and a polymer of furylvinyl or furylisopropenyl ketone.

BASEBALL. J. B. Dickson, R. A. Stafford and P. E. Blanchfield (to A. G. Spalding & Bros., Inc.). U. S. 2,278,649, April 7. A core for a durable sluggish baseball is made of a polysulfide plastic, polyvinyl chloride, an isobutene resin or synthetic rubber.

LAMINATED PLASTIC. B. S. Garvey and D. E. Henderson (to B. F. Goodrich Co.). U. S. 2,278,777, April 7. Joining a plasticized vinyl chloride resin to a sheet of interpolymer formed from butadiene and acrylonitrile or methacrylonitrile.

VINYL FORMATE RESIN. W. O. Herrmann and W. Haehnel (to Dr. Alexander Wacker Ges. für Elecktrochemische Industrie G. m. b. H.). U. S. 2,278,783, April 7. Esterifying polyvinyl alcohol with formic acid and adding methanol to precipitate polyvinyl formate containing 15 per cent free hydroxyl groups.

LAMINATED PRODUCT. D. V. Sarbach (to B. F. Goodrich Co.). U. S. 2,278,802, April 7. Joining natural rubber to a butadiene:acrylate ester interpolymer by an interlayer of butadiene:acrylonitrile interpolymer.

VINYL CHLORIDE COMPOSITION. R. A. Crawford (to B. F. Goodrich Co.). U. S. 2,278,833, April 7. A composition of plasticized gamma polyvinyl chloride and vulcanized neoprene.

CAST RESINS. R. T. Fields (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,278,858, April 7. Apparatus for casting synthetic resins in tubular shape.

EXTRUDED POLYMER. G. D. Graves (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,278,875, April 7. Apparatus for extruding a polymer melt under pressure to prevent bubble formation in the melt and in the extruded polymer.

PIGMENTED POLYMER. G. P. Hoff (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,278,878, April 7. Incorporating a delustering pigment in a partially polymerized resin comprising a synthetic linear polymer capable of melt spinning or cold drawing.

COMPOSITE FABRICS. E. W. Rugeley, T. A. Feild, Jr., and J. F. Conlon (to Carbide and Carbon Chemicals Corp.). U. S. 2,278,895–6, April 7. Reinforcing textile fibers with partially fused fibers of a water-insoluble resin; and partially fusing water-insoluble resin fibers to staple fibers.

BINDER FOR FIBERS. Carl E. W. Oesterreich. U. S. 2,278,943, April 7. A binder for fibrous materials is formed by adding an alkali solution of a resol to a hot aqueous lecithin dispersion, and compounding this dispersion with wood tar, waterglass, sugar and rubber latex.

PRINTING ROLL. P. K. Frolich (to Standard Oil Development Co.). U. S. 2,278,982, April 7. Forming ink rollers from a sulfurized isobutene:butadiene resin.

DENTURES. Max S. Shapiro. U. S. 2,279,067, April 7. Molded bases and teeth of dentures are made of an acrylate ester resin compounded with feldspar to imitate porcelain.

CASEIN GLUE. T. Sparre (to Borden Co.). U. S. 2,279,096, April 7. Glue formed from casein plasticized with urea contains sufficient formaldehyde to harden the plasticized casein.

SAFETY GLASS. J. D. Ryan (to Libbey-Owens-Ford Glass Co.). U. S. 2,279,145, April 7. As an interlayer in safety glass, a transparent resin formed by acetalizing a partially hydrolyzed polyvinyl ester and plasticized with a diethyleneglycol ether-ester.

GARMENT EDGING. N. E. Randall (to Columbia Narrow Fabric Co.). U. S. 2,279,206, April 7. Elastic edges for garments are interlaced with stiff filling yarns of a synthetic plastic.

RELIEF MOLDING. F. H. Shaw (to Shaw Insulator Co.). U. S. 2,279,208, April 7. Molding designs in relief on organic plastics, and molding plastic of a different color around the design.

ADHESIVE. J. G. Mark (to Dewey and Almy Chemical Co.). U. S. 2,279,256, April 7. A waterproof adhesive, in emulsion form, contains depolymerized rubber, rosin or copal, another less acidic resin and less than 1/3 as much casein as resin.

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British Plastics Year Book, 1942

Published by Plastics Press, Ltd., Sydney Road, Bedford England

Price 15/net **464 pages, indexed**

Another war volume, the twelfth edition, is complete although curtailed due to paper restrictions and other war circumstances. Indexed in nine sections covering editorial, names and addresses, proprietary names, materials, plant and equipment, manufactured products, associations, etc., who's who in the industry, data, the entire field of British plastics is briefly and very ably covered. Special articles include a review of patents on phenol-formaldehyde resins by A. J. Buck, A.R.C.S., a review of Nylon patents by R. E. Bowman, B.Sc., A.I.C., a review of recent ethenoid resin patents by Dr. C. A. Redfarn and the progress of cellulose acetate in 1941 as revealed by patent and technical literature by V. E. Yarsley, D.Sc., M.Sc., F.I.C.

Inorganic Chemical Technology

by W. L. Badger and E. M. Baker

McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, 1941

Price, $2.50 **237 pages**

The various unit operations involved in the manufacture of important inorganic materials, many of which in turn are required for the manufacture of organic plastics, are described in this textbook. It is intended for use in a course on the technology of the heavy chemical industries. The book is included in the publisher's Chemical Engineering Series. G. M. K.

Du Pont—One Hundred and Forty Years

by William S. Dutton

Charles Scribner's Sons, 597 Fifth Ave., New York City

Price $3.00 **396 Pages**

Out of the smoke and grime of a small gunpowder factory founded in 1802 by one Eleuthére Irénée du Pont de Nemours, on the banks of Brandywine Creek near Wilmington, Del., emerged a colossus of American industry, whose ramifications have reached into the lives of a multitude of people. The book is a biographical study of a business which, faithful to the legend of American industry, began as a small and limited enterprise; and which, fostered by men of vision and courage, grew to the gigantic structure we know today. It traces the development of this structure from those early days when gunpowder was its chief and only commodity, to the present when Du Pont numbers among its triumphant and successful contributions to "better things—for better living—through chemistry" a host of such diversified necessities as dyestuffs, viscose rayon yarns, cellophane, synthetic ammonia, photographic film, industrial alcohol, seed disinfectants, lacquers for automobiles, plastics, synthetic rubber and nylon. The Du Pont industries have come a long way since those early days of 1802, and closely entwined with the roots of this one great industry are the roots of all of American industrial development. L. C. A.

★ THE DELTABESTON SALES SECTION OF GENERAL Electric's appliance and merchandise department at Bridgeport, Conn., has just announced the release of a 16-page catalog on Deltabeston and synthetic insulated aircraft wires and cables. Comprehensive technical data are given in the catalog regarding specifications used for Deltabeston aircraft wires and cables, and size identifications and maximum current carrying capacities are listed. Tests describing tensile strength elongation, accelerated aging, oil absorption and flammability are included, as are short circuit, air oven, bend and flexibility tests.

★ A FOLDER OF *STOCK KNOBS FOR WAR INDUSTRIES* has just been issued by Chicago Molded Products Corp., Chicago, Ill., which illustrates and describes the numbers which they are now in a position to furnish. Fully detailed diagrams give exact specifications of each number available.

★ MACHINE MAINTENANCE WITH METALLIZING IS described in a 16-page bulletin, 42-A, just published by the Metallizing Engineering Co., Inc., Long Island City, N. Y. The booklet relates briefly how essential industries are eliminating replacements, and increasing service of equipment by building up worn diameters with sprayed metal. It also discusses metallized "inserts" which are described as helping manufacturers to conserve vital metals.

★ A TIMELY REPORT ON LUMINESCENT COATINGS has just been prepared by the Luminescent Coatings Committee of the New York Paint and Varnish Production Club, and published in the Official Digest of the Federation of Paint and Varnish Production Clubs. The report is devoted to a discussion of luminescent paints and coatings from the standpoint of known properties and uses at the present time, and an evaluation of their practical value and limitations.

★ *SILENT GEARS* IS THE TITLE OF A PICTORIAL story of the manufacture of two types of non-metallic gear materials manufactured by the General Electric Co.'s Plastics Div., Pittsfield, Mass. Fabroil and Textolite are the two non-metallic materials used, and suggestions for machining, installation data, load and gear specifications, dimensions of gear banks, are all incorporated in the booklet.

★ THE B. M. ROOT CO., YORK, PENNA., HAS JUST issued a new catalog, No. 120, picturing and describing their full line of single and multiple spindle boring machines used in woodworking industries, as well as for the boring of plastics and other composition materials.

★ A SPIRAL-BOUND, 40-PAGE BOOKLET CALLED *Plastics* issued by Sobenite, Inc., South Bend, Ind., is devoted to a brief and informative discussion of the thermoplastic materials, including photographs of equipment and applications.

★ A 4-PAGE BULLETIN, NO. 710 A, ON THE COMPANY'S hydraulic jacks has been issued by the Watson-Stillman Co., Roselle, N. J. Complete specification tables are given for all types of jacks manufactured by the company, which are also fully described and illustrated. The bulletin lists sizes of flexible copper pipe and fittings used with the independent pump jacks.

★ MAAS & WALDSTEIN CO., NEWARK, N. J., HAS PUBlished a booklet on U. S. Government Specification Finishes which provides makers of armament products with information on M & W finishes made to conform to Government specifications.

★ A LOOSE-LEAF CATALOG PUT OUT BY L. ALBERT & Son, Akron, Ohio, makers of machinery for the rubber and plastics industries, describes the historical and technical background of each class of machine, giving specific data on many individual units in each class. The firm's new presses and laboratory mills are discussed, and much information is given on machines made by other manufacturers and rebuilt by Albert. A 26-page section is devoted to engineering data which gives tabular material on such topics as horsepower of shafting, gear weights and dimensions, horsepower and torque, pitch diameter of gears, etc.

PROVING

EVERY DAY THAT THE VALUE OF TESTING DEPENDS ON THE QUALITY OF THE TESTING EQUIPMENT..

Bulletin #23 describes fully the equipment Olsen manufactures for every phase of plastics testing. Send for your copy.

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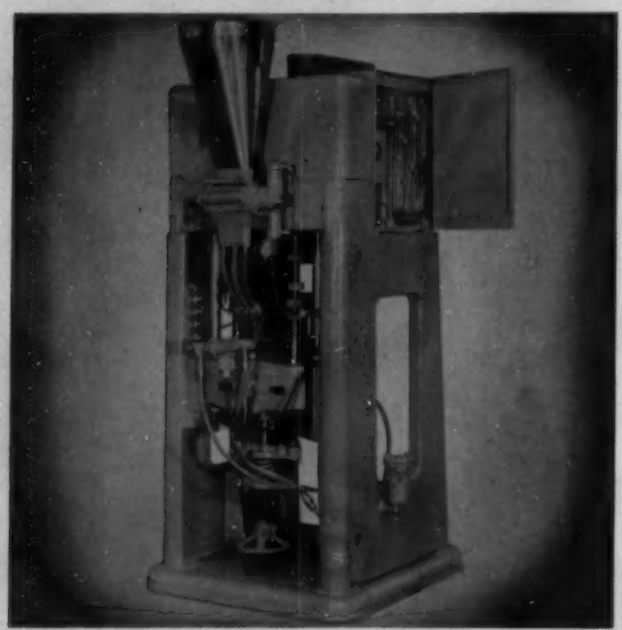
580 N. 12th Street, Philadelphia, Pa.

WESTERN REPRESENTATIVE
PACIFIC SCIENTIFIC COMPANY
Los Angeles • San Francisco • Seattle

Machinery and Equipment



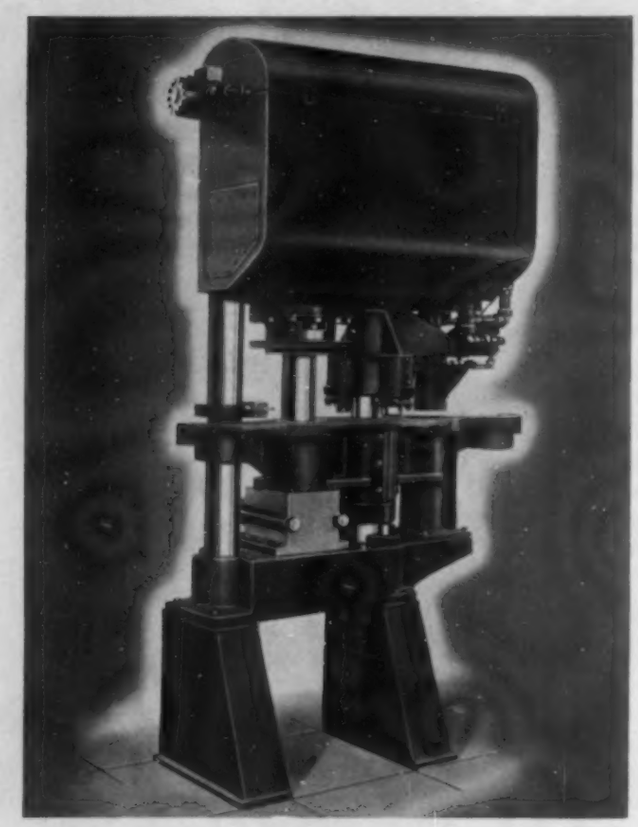
★ F. J. STOKES MACHINE CO. ANNOUNCES THE development of a new automatic compression molding machine (above) with a 4-cu. in. capacity for feed, as against the 3-cu. in. capacity in the feed of the earlier model. The hopper for the feed device has been constructed with shutters so that one, two or three feed chambers may be filled, depending upon the need. The feed chamber is provided with an adjustable threaded false bottom which is described as making possible accurate control of the quantity of molding material to be fed to the mold. The unit is provided with six air jets, and the entire air manifold may be moved forward in a straight line by means of an air driven cylinder to push off molded parts with a "kick." A safety check will stop the press in the event that air jets are not withdrawn from the mold area, and a system of lights on the thermostat indicate whether or not the mold is at the correct temperature. The unit is also provided with a reset counter which records the number of pieces molded.

★ TEC PENCIL CO. HAS PUT ON THE MARKET A NEW mechanical drafting pencil and motor-driven pointer which it claims will save time in the drafting room. Exclusive feature, the company says, is a full-length tube of spring brass which grips the lead firmly but does not cause it to break. Pencil barrel is of lightweight cellulose acetate. The motor-driven lead pointer starts and stops automatically, eliminates pointing with file or sand pad.

★ MEAD SPECIALTIES CO. ANNOUNCE A NEW TYPE hold-down for drill press work called "Air Clamp" that is said to speed up drilling operations from 30 percent to 300 percent, depending upon the nature of the work. It is adapted for use on any drill press having a cylindrical column and is quickly attached by means of a divided collar which clamps in any desired position. The working head is mounted on a heavy horizontal arm which slides in a split boss on the column collar. Two hand levers hold the head in any desired position so that pressure may be applied in any direction and at any point on the work regardless of size or shape, within the capacity of the drill press.

★ ATLAS EQUIPMENT CO. SUGGESTS ITS NEW DIE-filing machine for all kinds of die-making. The overarm is constructed so that file and saw attachments may be interchanged with little effort, and holddown fingers are attached directly to the overarm. The chuck consists of movable hardened jaws holding both saws and files. The unit operates with a $^1/_4$-h.p. standard type motor, with a speed of 1750 r.p.m.

★ RECENTLY ADDED TO ITS LINE OF DELTA-MILwaukee machines is the new carbide tool grinder available from Delta Manufacturing Co. The machine is constructed with a cast iron frame which encloses a motor of the reversing type, equipped with sealed ball bearings. The reversing switch is built directly into the cast iron base. Two manual brakes are built into the head so that the grinder can be slowed down and stopped for reversing. Two 1-in. by 6-in. steel-backed silicon carbide wheels with a 1-in. face, and $1^1/_4$-in. hole, are mounted onto the motor shafts, one of 60 and the other of 120 grit. The speed is 3450 r.p.m.



★ NEW 125-TON EXTRUSION PRESS (ABOVE) SAID TO permit simultaneous loading and extrusion has been developed by the Watson-Stillman Co. The new unit extrudes carbon mixtures, and is also described as being suitable for extruding any plastic material. The press has two containers, mounted on a swinging arm. The automatic extrusion cycle is started by push-button control, and then the operator may devote his attention to loading the free container. The container arm is provided with lifting cylinders for easy swinging and with hold-down cylinders to seal container against die during extrusion. The press is 10 ft. high, and requires 4 ft. by 3 ft. floor space.

Mold Automatically

10% MORE PARTS PER POUND

- You conserve molding material when you Mold Automatically . . . 8% to 10% or more . . . important savings at any time, particularly important now.

- You conserve tool steel . . . automatic molds, with only one or few cavities, require only a fraction of the steel that goes into the conventional large mold. This is a vital saving.

- You conserve tool-makers' time . . . automatic molds are quickly made . . . are ready to go into production weeks ahead of conventional molds. Saving time and labor are urgent.

- You produce parts of highest quality . . . that meet the most exacting Army and Navy specifications . . . reducing rejects to a minimum, less than 3% in specific instances.

These are only some of the savings that make Automatic Molding an ideal production method . . . for today's requirements, and tomorrow's.

For these machines perform all the functions of the molding cycle automatically. They are one answer to the growing labor shortage. A single skilled operator, to change molds, set-up and retime machines, can attend a whole battery of Automatics. Typical installations of a dozen to two dozen machines are being operated in this manner.

Automatic Molding also saves molding time, reduces cycles 50% or more in many cases, because automatic operation saves every split-second and performs some steps in the molding cycle simultaneously.

Automatic production is high. Not only are cycles shortened, but operation is continuous, 168 hours per week, with weekly output per cavity up to 10,000 or more parts.

Want more information?

F. J. STOKES MACHINE COMPANY
5934 Tabor Road Olney P.O. Philadelphia, Pa.
Representatives in New York, Chicago, Cincinnati, St. Louis, Cleveland, Detroit
Pacific Coast Representative: L. H. Butcher Company, Inc.

F.J.Stokes MOLDING EQUIPMENT

FJS Est. 1895

In the plastics picture

★ THE JOHN WESLEY HYATT AWARD, CONSISTING of a gold medal and $1000 in cash, will be made this year for the first time to the individual considered by the award committee to have made the most significant contribution to the progress and welfare of the plastics industry in 1941.

Shown above is Paul Manship (right), world-famed artist and sculptor, with Ralph W. Hyatt, son of the founder of the plastics industry. Mr. Manship, who at 23 was one of the youngest artists ever to be honored with the Prix de Rome, has had a distinguished record of unbroken successes since that early triumph. Best known among his works are such masterpieces as his "Diana," "Dancing Girl and Fawn," "Indian and Pronghorn Antelope," "Abraham Lincoln—The Hoosier Youth," the Prometheus fountain at Rockefeller Center, New York City, and the Woodrow Wilson Memorial in Geneva.

Mr. Manship has long since served his novitiate as a medalist, and outstanding among his achievements in this phase of the arts are the Roosevelt Memorial medal, designed in 1931 to commemorate the inauguration of the 31st President of the United States; the St. Paul's Institute medal; the Civic Forum medal for distinguished service during the last war, and the Dionysius medal for the Society of Medalists.

The John Wesley Hyatt medal consists of a profile relief of John Wesley Hyatt and has been executed with the artistic integrity and perfection of workmanship which have distinguished all of Mr. Manship's great works.

As previously announced in MODERN PLASTICS, November 1941, the award is sponsored by the Hercules Powder Co., Wilmington, Del. Final recommendations were made to the award committee by April 30, 1942, and candidates for the award are now being considered.

★ MONSANTO CHEMICAL CO., SPRINGFIELD, MASS., announces that Charles F. Reeves will manage the Washington Bureau of the Monsanto Plastics Division.

★ MILITARY TRANSPORT AIRPLANES CONSTRUCTED almost entirely of non-strategic materials will be built by the Curtiss-Wright Corp., Robertson, Missouri, it was announced recently. The new aircraft type is slated for use to transport personnel, equipment and supplies to distant combat areas, and will be built of wood and materials not included in the list of military priorities. Metal will be used only at points requiring extreme strength. In order to speed output, a great percentage of the structure will be subcontracted to furniture manufacturers and other woodworking organizations.

★ TWO PAPERS ON CELLULOSE PRESENTED AT THE April meeting of the American Chemical Society at Memphis, Tenn., contained information of interest to manufacturers of cellulose products. Drs. W. T. Haskins, R. M. Hann and C. S. Hudson, of the National Institute of Health, who described their preparation of synthetic cellobiose, made a contribution to the knowledge of the cellulose molecule which should be of value to makers of explosives, rayon, plastics and transparent wrappings. Dr. R. F. Nickerson, of the Mellon Institute, explained the difference between the cellulose molecule and those of wool and rubber: the former is not kinked, hence imparts no quality of stretch or bounce. An understanding of the molecular structure of cellulose is necessary for those who are seeking to substitute cotton for silk, hemp, nylon or other hard-to-get fibers.

★ MORE THAN 100 REPORTS AND PAPERS ARE scheduled for presentation at the 18 technical sessions and 150 committee meetings to be held during the 45th Annual Meeting of the American Society for Testing Materials at Chalfonte-Haddon Hall in Atlantic City, N. J., from June 22 to 26, 1942. Detailed reports of papers and meeting dealing with plastics will appear in our monthly Technical Sections.

Among the papers to be read are a Report of Committee D-20 on Plastics, W. E. Emley, Chairman; "Mar Resistance of Plastics," by Ladislav Boor, American Cyanamid Co.; "Mechanical Tests of Cellulose Acetate—Part II," by W. N. Findley, University of Illinois; "Ignition Points of Plastic Materials" and "Acid and Alkali Resistance of Plastic Materials," by John Delmonte, Plastics Industries Technical Institute.

★ THE QUEBEC RUBBER & PLASTICS GROUP elected the following executives for next season at the final meeting of the current season held on May 8 at the Ritz Carleton Hotel, in Montreal, Canada: Peter Gunter, Mack Moulding Co., chairman; A. B. Lewis, British Rubber Co., vice chairman; Dr. R. V. V. Nicholls, McGill University, secretary-treasurer.

★ SYNTHETIC MATERIALS REIGNED SUPREME AT the Lewis & Conger "Ingenuity Show" held in New York City in May. The place of plastic replacements for the duration was indicated in a series of exhibits showing apparel, household accessories and major equipment, and industrial applications.

★ SEMI-ANNUAL MEETING OF THE A.S.M.E. SUBdivision on Rubber and Plastics is scheduled for June 8, at the Statler Hotel, Cleveland, Ohio. The program is divided into two sessions, the first on properties of plastic materials, and the second on synthetic rubber and special rubber compounds.

★ GEORGE W. DE BELL, FORMERLY WITH THE Glenn L. Martin Co., has joined the Thomas Mason Co., Stamford, Conn., in the capacity of chief engineer.

★ THE "VICTORY HOME" SPONSORED BY *SMALL Homes Guide* as a solution to the need for privately built, low-cost houses in defense areas, was opened at 2129 S St., N. W., Washington, D. C., on April 30. Through the use of such materials as plastics, stone, paper, cotton and wood in both construction and furnishings of this home, approximately 78 percent of critical materials were saved. A special display of plastics parts contributed by several plastics manufacturers and suppliers is also a feature of the exhibit, though many of these are becoming scarce at present. The exhibit is scheduled to run for three months.

(*Please turn to page 90*)

Amos wants a greater opportunity to serve America and her allies in the greatest battle for production of all time. Amos molded parts are now going into the manufacture of numerous military devices, instruments and machines for the successful prosecution of the war—*but we want to do more!* Our facilities and equipment for the production of all kinds of injection molded parts are among the best. Expert designers and skilled craftsmen are ready to start immediately on your project, and follow through with maximum output without delay. Write or wire Edinburg office or phone nearest office for recommendations or for a representative to call.

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CHICAGO, Phone Harrison 5473; DETROIT, Phone Trinity 12283; ST. LOUIS, Phone Rosedale 5342; CLEVELAND, Phone Prospect 1720; DAYTON, Phone Adams 8161; NEW YORK, Phone Plaza 82251; ROCHESTER, Phone Monroe 6484R; CINCINNATI, Phone Highland 3336

AMOS MOLDED PLASTICS

★ THE 15TH SEMI-ANNUAL MEETING OF THE EASTern Photoelasticity Conference is scheduled for Saturday, June 20, 1942. It is to be held at the University Club, 40 Trinity Place, Boston, Mass. Those interested should address their inquiries to W. M. Murray, Massachusetts Institute of Technology, Cambridge, Mass.

★ EDWARD V. OSBERG, FORMER EXECUTIVE EDITOR of *India Rubber World*, has just been named vice-president in charge of all sales and technical services of the Wilmington Chemical Corp., Wilmington, Del., and 10 East 40th St., New York City.

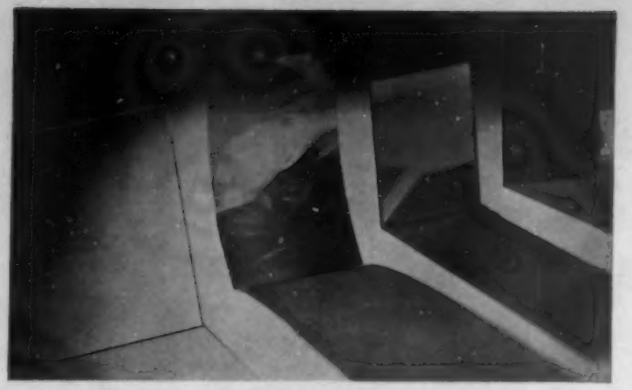
★ CARLETON ELLIS, JR., OF PLASKON CO., INC., formerly with the Toledo office, now makes his headquarters at that company's Washington division, Rm. 806, McLachlen Building, Washington, D. C.

★ A NEW LAMINATED, ELECTRICAL INSULATING material, reported to have approximately ten times the arc resistance of other laminated materials in its line, has recently been developed by the Formica Insulation Co., Cincinnati, Ohio.

★ A WATER-WHITE TRANSPARENT LIQUID FOR PROtective coating of drawings made on paper, blueprints, maps, etc., has recently been developed by Protective Coatings, Inc., 10391 Northlawn Ave., Detroit, Mich. The product, called "30," dries to a flexible film that is said to add strength to the paper, and to provide a surface that is resistant to moisture, acids, grease, dirt, etc.

Plain steel drums lined with new corrosion-proof solution

★ A NEW ORGANIC CHEMICAL REPORTED BY THE Merrimac Division of Monsanto Chemical Co., Everett, Mass., as a factor that will save tens of thousands of pounds of tin a year, has just been developed. Known as D.P. Solution, the material, when added in small amount to clear lacquers, alcoholic shellacs and nitrocellulose solutions such as pyroxylin and collodion, is said to prevent corrosion of iron by these products, making it possible to ship them in plain steel drums (pictured above) instead of in the tin-lined containers required in the past. Its action is ascribed to the fact that it reacts with iron to form an insoluble film which, though of but microscopic thickness, is sufficient to protect the surface. In case of breaks, it is self-mending. The use of D.P. solution is reported as being more economical than tin-lining, even if sufficient tin were available for such an application. In addition to inhibiting corrosion, D.P. solution is described as having demonstrated its value as a flocculating agent for maintaining good suspensions of the flatting agent in flat lacquers. The majority of lacquers contain sufficient flocculating agent introduced through solvents, nitrocellulose or flatting agent itself to prevent settling, but it has been reported that with D.P. Solution this condition can be assured in almost any lacquer. D.P. Solution is not recommended for pigmented lacquers inasmuch as pigments absorb it from solution and render it ineffective. Neither is it recommended for use in paints or synthetics which dry by oxidation, as it will precipitate the driers.



Illustrating new metalizing process are, left to right: clear plastic sheet, very thin sheet with transparent metal coating, front and rear views of new plastic mirror (trench size) reflecting metalized plastic initials in foreground

★ A NEW PROCESS FOR PRODUCING AN IMPROVED type of flexible, nonbreakable mirror has recently been announced by Flexmir, Inc., Newark, N. J. The mirror is said to have excellent reflecting qualities, to be proof against chipping or flaking and can be made in any color.

This new technique permits an application of an exceptionally light metal coating or film to a flexible elastic carrier (or plastic sheet) in a manner which forms a transparent type of reflecting layer, the silvering of which is not exposed to any mechanical stress when the carrier is bent. Thus, the reflecting metal coating will not chip or crack off. The reflecting coating is backed with a protective coating. Any gage or any type of plastic can be used for the mirrors, according to the report, from a minimum thickness of .00070 to .125 in. thick or more. The mirror may also be made to magnify or reduce by shaping the carrier correspondingly. Due to the flexibility of the mirror film and protective coating, this process permits engraved, embossed effects or printed signs or pictures if mirrors are to be used for furniture or other types of decorative panels.

Transparent optical qualities are described as excellent, as test reports indicated that no deformation or distortion was evident after samples were exposed to temperatures of 160 deg. F. and −40 deg. F. for four hours. After a 50-hr. salt spray corrosion test, there was no breakdown of the mirrored surface, the tests showed. Since the mirrors are claimed to be shatterproof, they are suggested for private or military uses (such as trench mirrors pictured above), for surgical kits, fluorescent light reflectors, truck reflector buttons, jewelry, initials (above), lamp shades, etc. The thinner gages may be put to many uses since the processed material may be softened and stamped into any shape without losing the shiny silver or gold effects.

Max Blank, president of the company, reports that he is also working on a method for metalizing plastic, cellophane and other types of yarn and claims to be able to treat cellulose nitrate yarn with a solution which inhibits burning.

★ SYNVAR CORP., WILMINGTON, DEL., ANNOUNCES the addition of a special phenolic resin called IWNAL, to its line. This resin is an alcohol-soluble type, containing a new group of hydrocarbons for impregnating wood, and is said to have extremely high penetration power and excellent chemical and water resistance.

★ McINERNEY PLASTICS CO., WITH MAIN OFFICES at 655 Godfrey Ave., S. W., Grand Rapids, Mich., has recently been formed for the purpose of molding, fabricating and extruding plastic materials.

★ HARKNESS W. CRAM, FORMER SALES MANAGER of the Aircraft Screw Products Co., Inc., 47—23 35th St., Long Island City, N. Y., was elected vice-pres. in charge of sales on May 1, 1942. (*Please turn to page 122*)

Metal Department
Offset Printing Department
Foil Stamping Department
Letter Press Printing Department
Engraving Department
Conveyor Assembly Lines
Laboratory
Polishing Department
Modeling Department
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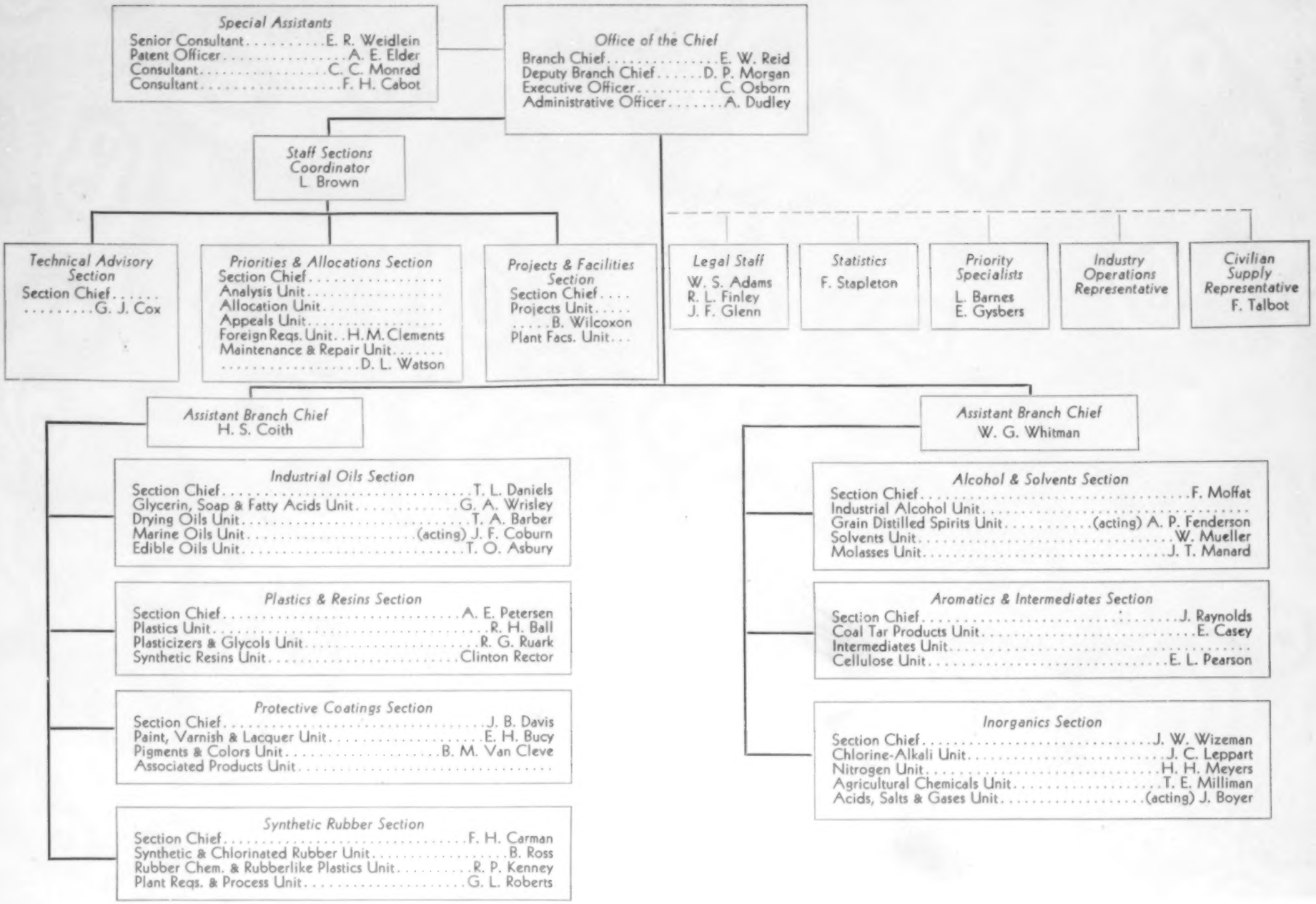
WAR PRODUCTION BOARD—*MATERIALS DIVISION*

THE CHEMICALS BRANCH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Senior Consultant . . . E. R. Weidlein
Patent Officer . . . A. E. Elder
Consultant . . . C. C. Monrad
Consultant . . . F. H. Cabot
Office of the Chief
Branch Chief . . . E. W. Reid
Deputy Branch Chief . . . D. P. Morgan
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Section Chief . . .
Analysis Unit . . .
Allocation Unit . . .
Appeals Unit . . .
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. . . D. L. Watson
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Section Chief . . .
Projects Unit . . .
. . . B. Wilcoxon
Plant Facs. Unit . . .
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W. S. Adams
R. L. Finley
J. F. Glenn
Statistics
F. Stapleton
Priority Specialists
L. Barnes
E. Gysbers
Industry Operations Representative
Civilian Supply Representative
F. Talbot
Assistant Branch Chief
H. S. Coith
Industrial Oils Section
Section Chief . . . T. L. Daniels
Glycerin, Soap & Fatty Acids Unit . . . G. A. Wrisley
Drying Oils Unit . . . T. A. Barber
Marine Oils Unit . . . (acting) J. F. Coburn
Edible Oils Unit . . . T. O. Asbury
Plastics & Resins Section
Section Chief . . . A. E. Petersen
Plastics Unit . . . R. H. Ball
Plasticizers & Glycols Unit . . . R. G. Ruark
Synthetic Resins Unit . . . Clinton Rector
Protective Coatings Section
Section Chief . . . J. B. Davis
Paint, Varnish & Lacquer Unit . . . E. H. Bucy
Pigments & Colors Unit . . . B. M. Van Cleve
Associated Products Unit . . .
Synthetic Rubber Section
Section Chief . . . F. H. Carman
Synthetic & Chlorinated Rubber Unit . . . B. Ross
Rubber Chem. & Rubberlike Plastics Unit . . . R. P. Kenney
Plant Reqs. & Process Unit . . . G. L. Roberts
Assistant Branch Chief
W. G. Whitman
Alcohol & Solvents Section
Section Chief . . . F. Moffat
Industrial Alcohol Unit . . .
Grain Distilled Spirits Unit . . . (acting) A. P. Fenderson
Solvents Unit . . . W. Mueller
Molasses Unit . . . J. T. Manard
Aromatics & Intermediates Section
Section Chief . . . J. Raynolds
Coal Tar Products Unit . . . E. Casey
Intermediates Unit . . .
Cellulose Unit . . . E. L. Pearson
Inorganics Section
Section Chief . . . J. W. Wizeman
Chlorine-Alkali Unit . . . J. C. Leppart
Nitrogen Unit . . . H. H. Meyers
Agricultural Chemicals Unit . . . T. E. Milliman
Acids, Salts & Gases Unit . . . (acting) J. Boyer

.....WASHINGTON NEWS.....

★ ALTHOUGH THE ORGANIZATION OF THE CHEMICals Branch of the Materials Division, WPB, may undergo further changes before it is approved by the authorities, the chart shown at the left will give some idea of the position of the Plastics and Resins Section within the Branch, and its relation to the other Branch Sections.

Chief of the new Plastics Unit of the Plastics and Resins Section is Dr. Ralph Ball (onetime Acting Chief of the Plastics Unit in the Organics Section), who is assisted by J. R. Turnbull, R. C. Martin and E. F. Swenson. Plasticizers and Glycols Unit Chief is Robert Ruark, his staff consisting of Arnold Kirkpatrick, J. S. Rogers, W. M. Hackman, John Conway and W. F. Holbrook. The new Synthetic Resins Unit is headed by Clinton Rector, whose assistants are Nils Anderson, R. L. Foote, Paul Kingsley.

The executive staff of Arthur E. Petersen, Chief of the Plastics and Resins Section, consists of John DeBell, H. M. Buffington and M. G. Reichman. The entire Section, with its twenty-odd technicians and usual complement of secretarial and clerical workers, is presently located on the second floor at the northwest corner of the Railroad Retirement Building, where it is hoped that plastics men will feel free to address them regarding their industrial problems. As plastics play an increasingly significant part in the war program, it is anticipated that the Section may increase its membership, possibly to 100 or more.

THERMOPLASTICS

The long-awaited thermoplastics order is in final form and scheduled to be issued before the first of June. It is said to have received clearance from the legal section of WPB. Only final clearance from the Central Clearance Committee, which must approve all priority orders before issuance, is now necessary before it is issued. Here is the way the order probably will work: All war orders (that is, those bearing an A-10 rating or better) must be completely filled before any of the four classes listed in the order can receive materials. The order then sets up four classifications for the further allocation of materials.

> Class I, on which a B-2 rating will be given, is composed of items which have functional uses essential to war production, such as industrial equipment, communications, transport and health. Items such as farm implements, safety goggles and machinery switches are included under this classification.
>
> Class II items, bearing B-4 ratings, must have a functional use and be essential for the civilian population. These would include such items as price tags for milk and dairy products, zippers, bicycle parts and household appliances.
>
> Class III items bear a B-6 rating, and must be useful though not necessarily essential, such as price tags for other than milk and dairy products, beauty parlor equipment, etc.
>
> Class IV is for novelties and non-essential items such as ash trays, ornamental buttons, etc. Production of all Class IV items is banned after the effective date of the order, except for those ordered and in the process of production before the effective date of the order.

The mechanics of the order are that all war orders must be filled first and then all Class I orders. If there is not enough to go around on Class I orders, each Class I order will be cut in equal proportion to the amount of the deficiency.

On any material left over after filling of war and Class I orders, Class II orders are to be filled up to 50 percent of the orders on hand.

If there is any material then remaining, it is to be split in equal amounts between the remaining 50 percent of Class II orders and the Class III orders. After the remaining 50 percent of the Class II orders have been filled, if there is any thermoplastic material left, it can go into Class III orders.

The order also provides that no one can use monthly more than $^1/_{12}$ of the amount of materials which he used in 1941 for manufacturing any item which would fall in Classes I, II or III.

There is a further provision allowing the use for manufacture of Class III items of 100 percent of the scrap thermoplastic material on hand without regard to the share-and-share-alike method affecting Class II and Class III, described above. In other words, re-worked scrap can be used for Class III items without considering any of the other classifications, with this exception: the scrap cannot be of such nature that it will be satisfactory for Class I or Class II items. If it is, then it must be used for those purposes first, if there is any shortage of material for those two classes. An arbitrary provision is set up in the order which states that scrap cannot amount to more than 15 percent of total production of new material.

It must be emphasized that this order has not received final clearance and may change before it is issued. But its general pattern will undoubtedly remain the same.

PHENOL ALLOCATIONS

A new system on phenol allocations may be used from June on, it was learned recently. The system seems likely to give the plastics section of the Chemicals Branch far more control and "say" in the distribution of phenols than it has had heretofore.

In essence the plan will work as follows:

The phenols section of the Chemicals Branch will continue to gather data on the availability—production—of phenols each month. After it estimates the production figure and deducts all export shipments and military usages from it, a meeting will be held to determine the distribution of the remainder. At this meeting all of the various WPB sections whose industries use phenols will be represented. They will each say how much phenol each one of their industries needs.

This, of course, may add up to more than the amount available. In such cases, a round table discussion will take place at which everybody will probably have to concede some ground; and then, finally, the amounts which each industry is to get will be arrived at. If there is a dispute about which industry gets what and it cannot be solved at this meeting, the decision is up to the Chemicals Branch Chief under WPB regulations. If one of the disputants is still dissatisfied, he can ask that it be taken up with the overall Requirements Committee of WPB. However, it is not contemplated that these latter two steps will be necessary in very many cases, if at all.

After the amounts which each industry is to get are decided on, the phenols section has little more than an administrative job to do. For each of the section representatives will then make the individual allocations and send them to the phenols section, which will administer the allocation.

For example, suppose the plastics section is allocated 15 percent of the June production of phenol for plastics manufacture. The plastics section will then determine how much phenol will be allocated to each individual company in the industry and direct the phenols section as to how the allocations are to be made.

The plastics section plans to accomplish this task by sending out a monthly questionnaire which will ask for inventories of phenols on hand, amounts used monthly, purposes for which phenols are used, ratings on orders and similar information which

Plant Reqs. & Process Unit.....G. L. Roberts

will give the complete supply picture and pattern of business as it relates to the war effort.

This system will be adopted also for other chemicals, being a new policy of the Chemicals Branch.

ENCOURAGE PHENOL OUTPUT

For some time the plastics industry has been concerned about the allocation of phenol. Through the use of extenders the necessary amount of phenol is reduced. For example, say that 50 units of a finished plastic can be manufactured with one unit of phenol: through the use of an extender, 100 units can be manufactured with the same amount of phenol. In such an instance, the supply of phenol would remain constant while the productive capacity was doubled.

It is not the purpose of the War Production Board to curtail the use of phenol, but rather to encourage the use of extenders to full capacity, thus increasing the output. It was to clarify this purpose that Arthur Petersen, Chief of the Organics Section of WPB, wrote the following letter to John Walker on behalf of the Plastic Material Manufacturers Association.

Dear Mr. Walker: Subject: *Phenol Allocation*

From reports which have come through to us from a number of sources, we believe that there is a misunderstanding among the plastic material manufacturers regarding the procedure used in the allocation of phenol, and that this misunderstanding may be operating to prevent the maximum use of extenders in the production of phenolic compounds.

We would therefore like to take this opportunity of correcting any misapprehension on this point and hope that you will circulate this information to those of your membership who are involved.

Each month the resin manufacturers submit their data on phenol requirements to the allocation unit. In the recent past, these requirements for essential uses alone have been away above the amount of phenol which could be allocated. All the phenol which can be made available for resin manufacturers in any one month is distributed among the resin producers in accordance with requirements which they present in this manner.

On receiving their phenol, the individual resin producers are free to extend as far as practicable and thus increase their output of compounds. It is our understanding that practically all of them are extending in this way.

We particularly wish to point out that the allocation of phenol for resin manufacture is not based on making provisions for the production of a certain specific poundage of compound. The actual procedure is that, after meeting Lend-Lease, Ordnance and certain very essential medicinal and chemical manufacturing requirements, every pound of phenol which we can find is allocated to resin manufacture. When the supply of phenol increases, more will be made available for resin manufacture since we need these resin compounds so badly. There need be no fear on the part of the resin manufacturers that they will receive less phenol because they have succeeded in extending their material and producing more compound than would be normally expected.

If any points about the above allocation procedure are not clear, we will be pleased to discuss them with you further or with the plastic material manufacturers either individually or as a group.

Yours very truly,
(Signed) Arthur E. Petersen
Chief, Organics Section
Materials Division
WPB, Chemical Branch

Mr. John Walker
Plastic Materials Mfrs. Assoc.

RAYMOND R. DICKEY

GOVERNMENT ORDERS

★ A RECENT AMENDMENT TO ORDER M-9-c PROhibits the use of copper and its alloys, including brass and bronze, to about a hundred-odd civilian products; other uses curtailed after June 15. The manufacture of the common household pin has been banned, and among other items on List A-1 are bulbs, neon and fluorescent tubes for advertising and display purposes, bulbs and cords for Christmas trees, dog collars, fountain pens and musical instruments.

★ BECAUSE THE WORDING OF ORDER M-19 RELATing to chlorine would have entailed the filing of monthly reports by thousands of retail stores throughout the country, it has been amended as of May 2 to remove that provision. With the exception of the change in reports requirements, the order is substantially the same as it was when issued on February 25.

★ AMENDMENT NO. 2 ISSUED MAY 12, 1942, TO GOLF club order L-93 permits golf club manufacturers to use completely fabricated plastic ferrules and caps which they may now have on hand. The original order prohibited the use of plastic materials in any form for this purpose.

★ J. S. KNOWLSON, DIRECTOR OF INDUSTRY OPERAtions, announced on May 13 that a revised form of application for priority assistance under the Production Requirements Plan was to be used for the third quarter of 1942. New instructions to applicants for preference ratings under the PRP will allow them to omit a considerable part of the information which has been required previously. Users of materials will be able to supply the same reports on PRP applications which they now prepare in answer to the general metals questionnaire, Form PD-275, thus avoiding duplication of paper work. Under the new program, assignment of ratings to PRP applicants will depend more on the nature and use of the applicant's product than on the preference ratings of the orders on his books.

★ WPB ORDER M-147, RELEASED ON MAY 9, REstricts the importation of cashew nuts beginning with May 20. The purpose of this order is to insure maximum extraction of oil from cashew nut shells in the exporting country. The order does not apply to nuts aboard a ship on May 20. Cashew nut shell oil is a valuable war material used for making electrical insulating material, plastics, paints and varnishes, paper, and as a pigment in a number of manufacturing processes.

★ BY THE TERMS OF CONSERVATION ORDER M-105 issued by WPB, distribution of naphthalene will be placed under rigid allocation control beginning with June 1. After that date, except for exempted types of delivery, all naphthalene shipped by a producer or distributor must be delivered in accordance with schedules issued by the Director of Industry Operations at the beginning of each calendar month. Restrictions do not apply to deliveries made solely for the purpose of refining.

★ CHANGED PREFERENCE RATINGS FOR ALL PERmitted uses of chlorinated hydrocarbon solvents were announced by the Director of Industry with amendment of Order M-41, which extends A-10 ratings for such solvents to be used in the fumigation of stored products, including grain; for charging and recharging fire extinguishers; for laboratories, hospitals, and public institutions; for processing and manufacturing food, chemicals, rubber, petroleum and plywood; for cleaning metal parts of electrical equipment; for manufacture of refrigerants; and for degreasing machines used in making of war materials.

★ THE WAR PRODUCTION BOARD HAS AUTHORIZED the Reconstruction Finance Corp. to provide facilities for an annual productive capacity of 700,000 tons of Buna S synthetic rubber to be in operation not later than the end of June 1943. This represents an increase of 100,000 tons in the Buna S program previously authorized by the War Production Board, and is in addition to the planned capacity for Butyl synthetic rubber and neoprene totaling 100,000 tons. All priority and allocation assistance needed to assure the production of not less than 350,000 tons during 1943 is to be accorded the Buna S program, and all synthetic rubber to be produced for many months must be reserved for military uses.

★ FORMS FOR REGISTRATION OF ALL DEALERS selling waste, scrap and salvage materials to consumers are now being printed, and effective May 20 all dealers must register with OPA on or before June 20th. All registration statements are to be mailed to the Bureau of Census, acting as OPA collecting agent.

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London Letter

THE most detested and abused word in the business man's vocabulary today is "Priorities." Priorities are now only too well known to American industry and therefore do not require defining. Sufficient is it to say that in Great Britain they have most effectively curbed all peacetime industrial and commercial activities. Plastics are now virtually unobtainable except as priorities for war purposes, and undertakings which have started off to produce non-essential articles in plastics as substitutes for light metals have very soon been made to realize that plastics are subject to very effective rationing. An instance of this is the molded plastic petrol lighter which received the initial approval of the Board of Trade and Ministry of Supply and was heralded in the press with a good deal of ballyhoo—yet has come to nothing. The reason is simple: inability of the plastics industry to supply the material. Incidentally the design of the so-called official pattern lighter was deplorable and it is, perhaps, a good thing for British prestige that it was stillborn—a premature and ill-formed offspring.

The secrecy which now surrounds the plastics industry has been taken to such extremes that it has become almost ludicrous. If manufacturers show you any new developments or discuss the properties of new materials it is all done sub rosa and unofficially, whilst officially you are forbidden to publish a word. This may be great fun for the manufacturers and the appropriate Government Department but it's difficult and extremely tiresome for press correspondents and publicists. Pick up either of the two technical journals catering to the plastics industry and what do you find? A succession of reprints from American sources or mild reviews of prewar or postwar developments. Yet in our midst, here in Great Britain, sensational things are happening and plastics are making vital contributions to the war effort. Admittedly, many of these things are secret, but there are surely some wartime applications and wartime materials which could be given publicity so that industry at large could be told what plastics are doing.

A few weeks ago a prominent British aircraft designer made a slashing attack on the use of plastics for aircraft construction and this lecture, which incidentally has been given wide publicity in the technical press, has done a great deal of harm to the plastics industry. In your correspondent's opinion the attack was unfair inasmuch as conclusions were drawn mainly from a comparison of the physical properties of metals and plastic materials. No one denies that the light metals are ideally suited for constructing the large bombers and the modern fighters, but the point ignored was that aluminium and magnesium, the two basic metals of the aircraft industry, are rather precious these days and have to be imported from abroad; and that for its own interests the aircraft industry should not shut its eyes and close its ears to the claims of other competitive materials. Plastic materials cannot yet compete with metals in the construction of the modern type of warlike aircraft, but there is a growing field for all kinds of lighter craft for training and reconnaissance where plastic materials in conjunction with wood are very suitable.

There is a small but growing body of opinion in aeronautical circles which views with concern what they term a "gold plating" policy of manufacture, and considers that a good case could be made out for cheaper and less expensive (as regards materials) methods of production. They emphasize the fact that for certain arms of the service, particularly the fleet air arm, one-flight aircraft which have to be catapulted off auxiliary warships are needed in great number. So also are gliders, which are only good for one flight. Here, obviously, wood and plastics are the ideal materials.

The labor problem is becoming more acute as more men and women are being conscripted for the services, national defense work and munitions and the Ministry of Labour has under constant review all reservations of manpower. The plastics industry is today being largely run by juveniles, mostly youths, and this may have an important effect in the future if, as some progressive firms are doing, steps are taken to educate employees and so prepare the way for their future advancement.

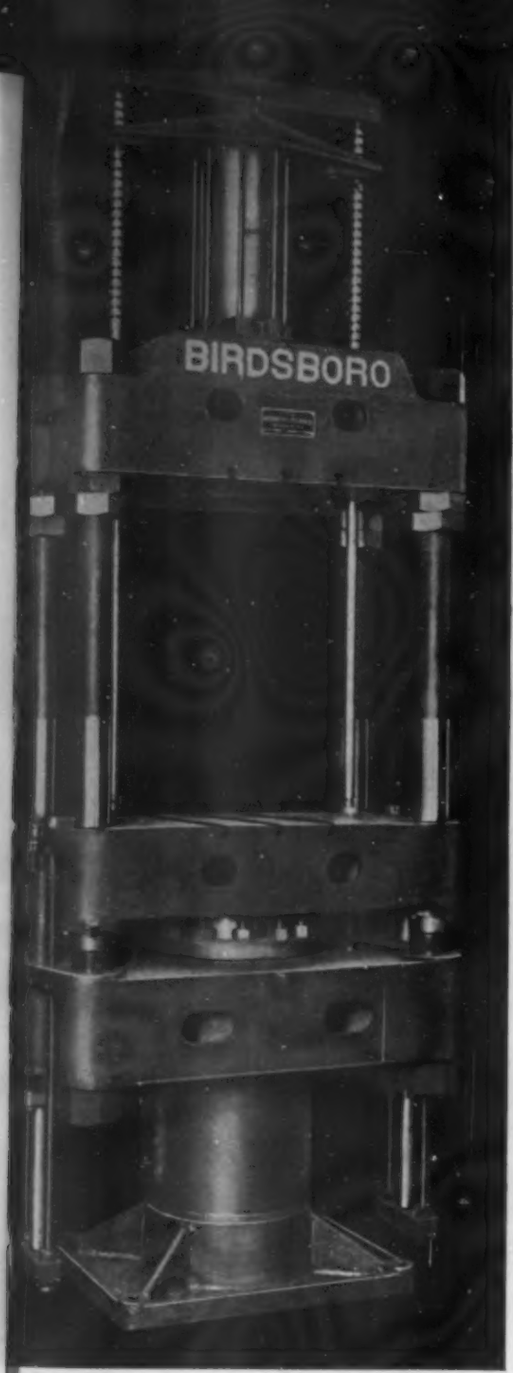
As described in a separate contribution to MODERN PLASTICS some little time ago (May, 1942, p. 98) there is a growing interest in synthetic rubber and firms supplying these materials have been deluged with inquiries. They cannot, of course, supply more than a proportion of the demands. British manufacturers are working in the closest cooperation with American concerns in the development of new types of synthetic rubber and an instance of this is that considerable progress is being made in Great Britain with a view to making available the newer types of Thiokol, particularly FA and RD. The latter grade is of particular interest because it has no cold flow and, owing to its high resistance to oils and solvents, is particularly suitable for oil seals, gaskets, etc.

Somewhat belated but nevertheless very welcome is the action of the British Plastics Federation in setting up machinery to deal with all internal and external problems affecting the mold making, molding and material manufacturing sections of the industry. A committee has been formed and is already at work rendering assistance to industrial users of plastics, to potential users and to members of the Federation themselves. This step is of the utmost importance as being a well-planned measure designed to increase the scope for plastics and improve the general efficiency of the industry. The new committee has very aptly been called "The Plastics Brains Trust." (For the benefit of American readers, it might be stated that "The Brains Trust" is a B.B.C.-sponsored committee which broadcasts a quiz program once a week.)

At a recent luncheon held by the Institute of the Plastics Industry in London, Major Mohr, Chairman of the British Plastics Federation, described a novel wartime application of plastics: namely, for the construction of crates for pigeons used by the signalers of the fighting services in Eastern theaters of war. Until comparatively recently, the crates used for carrying messenger pigeons were made of wood, but it was found that these were quickly destroyed by termites and other pests and the pigeons, costing some £50 each, were consequently let loose. Considering that each crate holds some 20 pigeons, the busy white ants could very quickly liberate stock worth £1000 sterling, apart from dislocating a section of the military news service. The new laminated plastic crates, although much more expensive to produce, are definitely able to withstand the attacks of all insects as well as to resist mold and rot. The fact that plastics were chosen for this unique military application shows that the authorities are becoming fully alive to the fact that plastics are materials well able to solve tricky problems, particularly where insect or fungi damage is involved.

In the field of military applications of plastics, a good deal of publicity has recently been given to the substitution of plastics for metal in the production of buttons for the R.A.F. and the army. This has been going on some time and very large numbers of urea-formaldehyde resin buttons have been issued to the quartermaster side of these services. Incidentally, urea-formaldehyde has ousted casein as a button-making material, the main reason being that casein, when available, can be more profitably worked up for human consumption.

Vast quantities of powdered aluminum are now being used in the manufacture of implements of war, and manufacturers are now giving some thought to possible postwar applications. Naturally, the most interesting potentialities lie in the paint industry, but inquiries are being made as to likely developments in the realm of plastics. In Germany and in America experiments have been carried out using mixtures of molding powders



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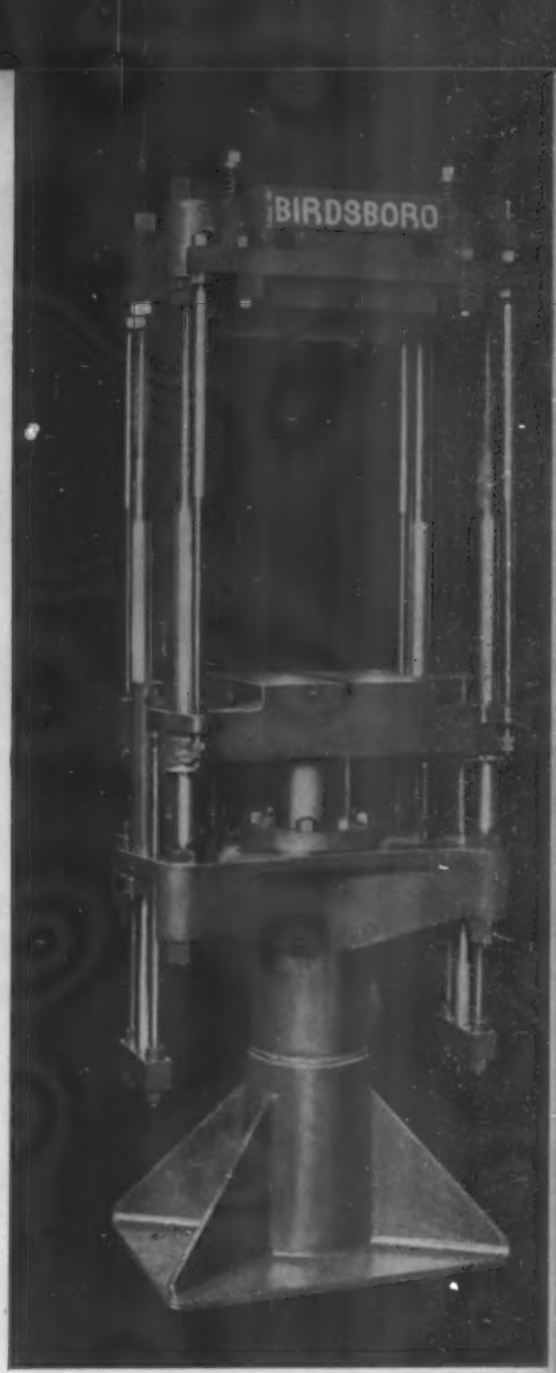

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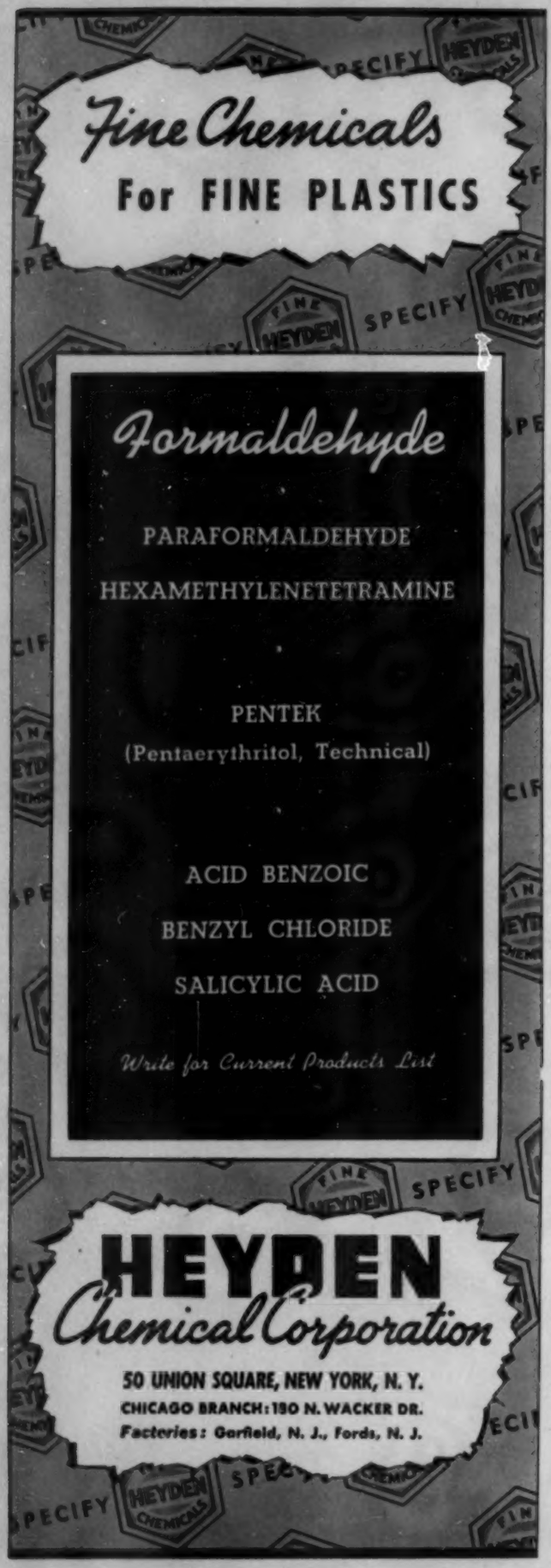

and powdered aluminum, copper, etc. Some of the results have been interesting and moderately encouraging and metallurgical concerns in Great Britain today are trying to induce the plastics industry to take a more active part in research. It is pointed out that the presence of aluminum powder in the resin would greatly improve the decorative effect of molded radio cabinets and fancy goods.

By today's mail I have had a long letter from my old friend the editor of *Plastics* (London), in which he asks me to make known in my next London Letter a suggestion for producing a heat insulating plastic using kapok as the filler. Apparently Mr. Curwen passed this idea on to a prominent American industrial concern twelve months or so ago, but he thinks that the letter never reached its destination and is probably with the fishes at the bottom of the Atlantic. There's still plenty of kapok in the West Indies and it has unique physical properties which might well justify the assumption that it would improve the heat insulating properties of plastics. It's a Lease-Lend idea which might be worth considering!

One of the largest electrical concerns in Great Britain has announced the production of an interesting material known as Silicone, and this announcement has whipped up interest in these new silicon compounds. Some years ago, for instance, a silicon ester was produced by a solvent firm and tentative experiments were carried out independently by at least one research chemist with the idea of impregnating wood or fabric, etc., with a silicon ester solvent solution of phenolic resin. The idea was that the silica eventually deposited throughout the structure of the material would improve its fire-resisting properties and also its strength. This is another idea which American chemists might think it profitable to study.

In spite of the energetic campaign now being waged to conserve stocks of plastics and re-use scrap, one often comes across frivolous applications. The other day your correspondent saw some cellulose acetate hair curlers, ingenious little devices but completely unnecessary in this war of supplies. The Ministry of Supplies is doing everything to prevent the wasteful use of these vital plastics but, if manufacturers are unscrupulous, ways and means will be found to defeat the Ministry. From inquiries made, it is certain that all plastic material manufacturers in Great Britain are bitterly aware that a stricter control will have to be placed on the use of plastics: they must be employed only for war work, and the luxury trades completely disregarded.

There's a sting in the tail of this jumbled letter and here it is: news from some of the largest metal pressing concerns in Great Britain indicates that extensive trials with press tools made of high density wood (resin impregnated) show that the material tends to foliate and cause trouble in regular use. Maybe this will be a grave disappointment for many people, but it's a headache which needs to be remedied at once and cooperative research can cure it. (*Mailed April 23, by Mrs. John S. Trevor*).

Steel-plywood trainer

(***Continued from page 45***) given a similar metal structure. In every test given, the report was: "No visible signs of strain at 105 percent load."

Fir, spruce, birch and maghogany are the woods which have proved most adaptable in tests thus far, it is reported, although it is likely that mahogany may have to be abandoned as a possibility because of the increasing difficulty of obtaining it. The plywood sheets range from 2-ply to 7-ply, and gages used most extensively are between $1/16$ in. and $5/32$ inch.

One of the major problems encountered in the fabrication of wood parts for planes is the means for fastening sections together for an assembly—a problem solved by spotwelding in connection with low alloy steel, and somewhat less efficiently by rivets in the case of aluminum alloys. Resinous glues, although previously used for plywood and other types

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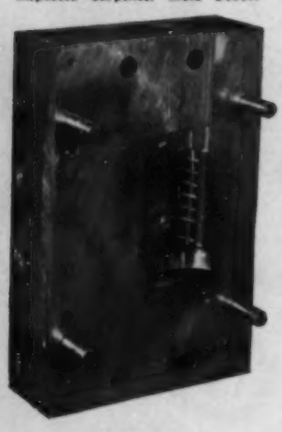

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of wood joining which lend themselves to mass production under special conditions, were found, however, to be not entirely practicable for this company to use for its large wood aircraft assemblies under its present set-up. It was discovered that providing the necessary heat and pressure conditions would be too costly, although resinous glues are being contemplated for use by this same company for smaller assemblies.

After extensive tests, which employed numerous specimens joined together with various glues under varying temperatures and pressures, permitted them to set and then strained them to the breaking point, the company found that the most suitable product for the purpose under consideration was casein glue. Parts fastened in this fashion with this material proved strong and durable when set at normal room temperature with the mild pressure of nail strips which could be quickly and easily removed when the joint had set. Casein glue, because of its simple method of application, has proved itself very well adapted to present methods of assembling built up structures.

The furniture industry, which is the source of supply for most of the wood used in planes, is now an arm of the aircraft industry—and they have enlisted in a body to help produce those 60,000 airplanes in 1942, 125,000 in 1943, the figures set by President Roosevelt as the number of American planes necessary to "keep 'em flying."

Credit—Manufacturer of planes: North American Aviation Co., Inc.

Rolling out production

(Continued from page 50) pre-formed core are then placed, in the final mold under intense heat and tremendous pressure. In a 6-in. wheel, for example, the two component parts are molded into one indestructible unit under a 2000-lb. per sq. in. pressure. The resulting material, which forms the completed wheel, is claimed to be infusible and insoluble.

The wheels were designed to overcome maintenance costs for floors, which become worn and chipped by truck or caster wheels. Laboratory test reports on these wheels demonstrated that the 6-in. model was capable of sustaining a 10,000-lb. load without exhibiting any signs of failure or malfunctioning. The construction of this new type of wheel was designed to eliminate impact fatigue and the possibility of striking sparks, which might result in serious losses from fires started in this fashion. These wheels are unaffected by most dilute mineral acids, and alcohol, as well as commonly used greases and oils. They are somewhat susceptible to hot concentrated alkaline solutions, but tests conducted showed that intermittent applications for brief periods seemed not to have a deleterious effect upon them, and they have also been tested and proved capable of withstanding continuous hot applications up to 200 deg. F.

A feature of special significance which is attributed to these new plastic wheels is the facility with which they permit movement of a load, and the ease with which a standing load is started rolling. This factor tends to reduce the fatigue element of the worker, which is a most important consideration in the high-geared production now so essential in all phases of industry.

Credits—Material: Phenol cresol aldehyde laminating varnish. ABK wheels manufactured by American Brakeblok Div., American Brake Shoe & Foundry Co. Distributed by Rapids-Standard Co.

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Vinsol resin

(*Continued from page 59*) economically for replacing present scarce materials or for new applications. It is at present used in low cost thermoplastics as a shellac substitute, in asphalt emulsions, foundry cores and mold facings, phonograph records, masonry cements, wood stains, match heads, fiberboard, and in paints for tank cars, wheels and fenders, gasoline pumps and structural steel. It plays an important rôle in motors and transformers where resistance to oil and grease is important, and in high voltage insulation.

The particular combination of properties which the resin possesses indicates its potential value for making low cost shellac substitutes, for lacquers and spirit varnishes, for plastics, thermoplastic binders, in plywood adhesives, for making fiberboard, carton board and tougher paperboard, in dark paints, and roofing compositions. Vinsol is now being produced in large quantities and facilities are at hand to increase this volume as the uses and advantages of the resin becomes more familiar to the trade.

Swelling of fillers

(*Continued from page 69*)

Discussion of data obtained in particle counts. As may be seen from Table II, the commercial fillers vary in their particle size. Materials which are naturally brittle or which are rendered brittle by artificial means show much more uniformity in particle size than resilient fibrous materials, for instance, cotton flock. In spite of the fact that these materials are on the market in various mesh sizes, it is evident that many fibers, even though quite long, pass the screen lengthwise and therefore given a false impression of the particle size of the filler.

In Table III, the count was made only on the groups which make up the bulk of the material. It shows that nut shell flour possesses greatest uniformity. All of the other materials vary considerably in their percentage uniformity.

In Table IV, the relation between normal fibers and split fibers is shown. Generally, two thirds of the fibers are intact while the rest are split, but there are cellulosic fillers on the market containing less than one-third intact fibers.

Conclusions

Inorganic fillers with the exception of asbestos fibers show the most regularity in particle size. This is due to the difficulty of pulverizing a resilient fibrous material to a uniform powder without great cost.

Organic fillers of the ligno-cellulose type are susceptible to considerable swelling in water and even larger swelling in caustic. It is interesting to note that ligno-cellulose fillers possess nearly the same swelling degrees as the pure cellulosic fillers. The swelling is greatly increased in the case of alpha flock or rayon waste. One specially prepared cellulosic powder shows very little swelling.

The harder the raw material, the greater the uniformity after milling (see nut shell flour). If the material is rendered brittle by artificial means, similar results are obtained (cotton flock D).

A laboratory method of determining the irregularity of the filler by microscopical count is described. Figures obtained by this count not only show the variety in particle size of the filler, but also the relation between particle sizes. The percentages of intact fibers and split fibers are also reported for various fillers.

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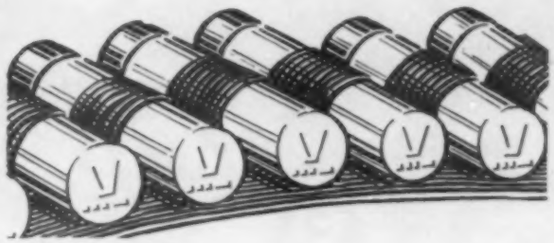

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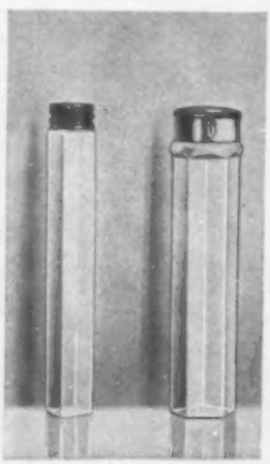

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Artillery ammunition

(Continued from page 47)

For our initial endeavor, a fuze was selected that is presently used in the mortar shell. This selection was made because it is known that this particular fuze is used in a shell that is fired at a very low velocity in comparison to other projectiles, and that no rotational spin is imparted to the shell when fired from a mortar. The set-back stresses encountered, due to rapid acceleration and to rotational spin, are at the absolute minimum. Three parts of this fuze were selected to be molded from plastic. One part, the body, is a complicated molding, due to the number and positions of internal cavities required to house the moving parts that are, shall we say, the clockwork of the fuze. The other two parts are rather simple moldings in comparison. The original molds for these parts were made with the use of thermoplastic material in mind. The plastic parts, on receipt, were given preliminary temperature tests. In these tests, the parts are brought to a temperature of 170 deg. F. and then to a low temperature of −40 deg. F. At the high temperature, the thermoplastic material definitely changed its shape sufficiently to cause the moving parts of the clockwork to bind and thus prevent free functioning. Thermoplastics have sufficient toughness to be suitable in this application so far as stresses are concerned, but they cannot satisfactorily withstand temperature variations. Temperature tests are essential, and of vital importance where storage of ammunition may be expected in hot and cold climates. Water absorption properties of the material are also of paramount importance. This factor must be kept extremely low where fuzes are considered, as conditions may prevail where storage is required under high humidities. Thermoplastic materials commercially available at the time the tests were made were therefore eliminated as a possibility for these parts.

The next step was to change over to the thermosetting plastics. With this material, satisfactory parts were obtained provided that a medium impact plastic was used, and that the many cavities in the body were not later machined to meet dimensions required. The smooth, unfinished surfaces obtained in molding were satisfactory and the sliding or moving parts functioned without failure. Some of these bodies made from rag-filled plastic were machined after molding in order to meet the required dimensions for the cavities. The machining brought out the roughness of the materials below the smooth resin surface, and in firing tests conducted, the fuzes failed to function. Examination showed that the sliding parts had failed to function properly due to friction in the machined cavities. However, these fuze parts when molded exactly to dimensions without after-machining were found very satisfactory, and passed all acceptance tests called for by the specifications. They withstood the hot and cold temperature tests without appreciable variations in dimensions. When loaded and assembled, these fuzes withstood the required jolt and jumble tests. The jolt test subjects the assembled fuze to 1750 jolts in each of three positions, after which it is placed in a fixture and put in a jumble machine which is given 3600 complete revolutions at a specified speed. These fuzes, when subjected to firing tests at the proving ground, produced satisfactory results.

Throughout the development of the three plastic parts for this particular fuze, minor changes were made by increasing tolerances and redesigning to facilitate molding. Converting to plastics was relatively easy for this fuze because the shell, as mentioned before, is fired at a very low velocity with no rota-

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tional spin. Another important consideration that cannot be overlooked is the factor of weight. For the mortar fuze, this factor is not of vital importance and the decreased weight obtained by using plastic instead of aluminum did not materially affect accuracy of fire. This, however, does not hold true when other projectiles are considered, such as the anti-aircraft shells and shells fired in the high-velocity guns. Here weight is of paramount importance for accurate firing, and plastic substitutes must meet the weight requirements established by the metal. This can be obtained only by loading the plastic material or utilizing inserts. In so doing we introduce such complications as the lowering of impact strength, and the necessity for redesign to preserve ballistics, etc.

A rather simple case in which weight is of prime importance is our dummy fuze used in the 37-mm. projectile for target practice. The fuze formerly obtained was made from aluminum and weighed 2.56 oz. It is an ideal item for duplication in plastics provided the weight is maintained. The dummy fuze machined from a solid piece of aluminum has a specific gravity of about 2.73. Plastics, in general, have a specific gravity of approximately 1.4. Thus, in order to meet the weight requirement, it becomes necessary to weight the material in some manner or employ a metal insert. Both have their bad points: if the material is weighted, the impact value is lowered; if an insert is used, it must be firmly anchored so that the set-back, when the shell is fired, will not free the insert. Also, when an insert is used, concentricity and perfect balance must be maintained. For this particular fuze, a high impact material (1.50 ft. lb. per in. of notch) was called for. It is believed a material possessing less strength would not withstand the stresses obtained due to rapid acceleration and high rotational spin.

Another case in mind in which a plastic substitute was given consideration was the fin assembly for the mortar shell. The fin assembly was molded over a metal tube insert. Several of these assemblies were fabricated and tested at the proving ground. In all cases, the difference in expansion coefficients of metal and plastics resulted in breakage and failure of the fins during firing. Further development of this component was not considered.

Considerable investigation has been carried on to develop a satisfactory windshield for the 20-mm., 37-mm. and 75-mm. projectiles. This windshield is a cone-shaped component that fits on the front end of the projectile. In the 20-mm. projectile, the windshield cap serves to increase the length of the armor-piercing projectile for use in the automatic feed mechanism. These caps were molded of cotton flock phenolic material of medium impact strength. In all tests at the proving ground, these caps failed in the feed mechanism. The impact received by the cap as the projectile was fed into the gun chamber caused failure. Our development was hindered considerably because no suitable method could be found to fasten the plastic cap securely to the steel projectile. The 37-mm. and 75-mm. windshields have received considerable study and investigation. These cone-shaped windshields are screwed on to the front end of the projectiles. Both projectiles are fired at high velocities and high rotational spins. The terrific acceleration imparted to these shells results in high set-back forces. Plastic windshields invariably failed by fracture through the threaded section. This difficulty has been practically overcome by reducing the number of threads and decreasing the diameter. At the same time, efforts have been and are being made to use plastics having much greater strengths, such as laminated cloth and paper. These materials are proving satisfactory in the high and low temperature tests. Firing tests have been conducted with windshields at

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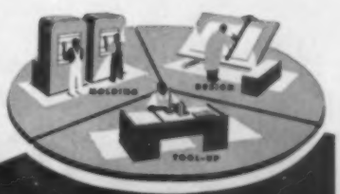

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normal temperatures; however, before final acceptance, these windshields will be fired at temperatures of −40 deg. F. and +170 deg. F.

It would be well to mention another instance where a mold was made to fabricate a booster body out of plastic. This body is now made of brass, and definitely is an extremely important part of the booster component in artillery ammunition. A molder may observe this component and judge that it is a "natural" for plastic material. Our calculations tell us that a plastic booster body when fired from a gun would have to withstand a force tending to rupture of 5384 lb. at a chamber pressure in the gun of 36,000 lb. per sq. in. Several plastic booster bodies were tested and failure resulted at loads varying from 1072 lb. to 1523 lb. Thus it can be seen that the strength of the plastic booster body is much below the strength required. To obtain a satisfactory booster body, a substantial change in design to eliminate the present critical sections would be necessary. A change at this time, however, could not be undertaken; and therefore the only possibility left would be to use a plastic material having strength four to five times greater than the type used in the molded samples tested.

The plastic suppliers, however, are not prepared to furnish an easily molded powder possessing strength of such magnitude—at least, not at present.

Thus when we delve more deeply into the problem confronting us in the substitution of plastics for metals in artillery ammunition, we begin to understand more clearly why certain requirements must be adhered to if we intend to supply ammunition to the using services that will meet time-proven standards. Ammunition must be safe under the roughest treatment it can possibly get in handling and transportation. It must function without failure after long periods of storage under every possible combination of temperature and humidity. It must not fail when subjected to the sudden tremendous internal stresses set up when fired in high-velocity weapons. It has been the Ordnance Department's job to furnish ammunition to meet all these requirements and our present designs and materials will guarantee these results. Any diversion from these designs and materials requires thought, development and testing, and one can readily understand why this cannot be done overnight. There are, of course, a few parts here and there which can be made from plastics with little or no experimentation. The important and critical parts are the very items that molders seek to replace with plastics; but to reach this goal we must first obtain that plastic compound which will offer the required strength characteristics and, secondly, will possess the all-important bulk factor so necessary to warrant rapid production and prevent any possibility of becoming a bottleneck in procurement.

Materials meet the threat

(Continued from page 43)

E-8. *Blush resistance.* The material after 24-hour immersion in distilled water at 75 ± 5 deg. F. shall show no evidence of blushing.

E-9. *Acetone Solubility.* The material shall show evidence of solubility in acetone when tested as described in Paragraph F-10.

E-10. *Shrinkage.* The material shall show a shrinkage of not more than 0.5 percent when dried in an oven for one week at 130 deg. F.

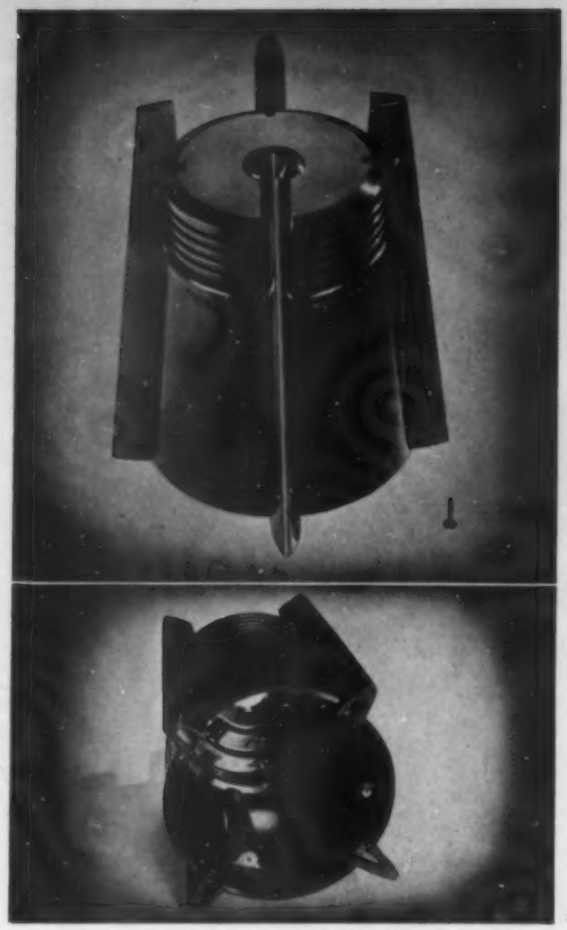
E-11. *Resistance to cracking.* The material when sewed to 10-ounce cotton duck as described in Paragraph F-12 of this specification, shall show no radial cracking from the points of perforation.

METHODS OF SAMPLING, INSPECTION AND TESTS

F-1. (Same as molded lens.)

F-2. *Sampling.* All sheets and rolls shall be visually examined for optical defects.

(Please turn to page 110)



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Both these pieces were molded by the transfer molding method. The large piece is a housing for a blendor. It weighs 1 lb. 5 oz., stands about 8¼" high and is 7" wide at the widest diameter. It represents an outstanding achievement in this type of molding, both from the point of view of mold construction (difficult undercuts and channels) and of production. It is molded in a double-cavity mold of Neillite. Total charge is 3 pounds. The tiny piece weighs only a fraction of an ounce. It was also molded by transfer.

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F-2a. *Sheets.* One sheet shall be selected at random from each lot as a representative sample, to be inspected and tested for compliance with the other requirements of this specification.

F-2b. *Continuous rolls.* A sample of plastic 20 inches long and the width of the roll shall be selected at random from a roll as a representative sample, to be inspected and tested for compliance with the other requirements of this specification.

F-3. *Lot size.* Unless otherwise specified in the invitation for bids, a lot shall consist of 100 sheets or one continuous roll. Each sheet will be indelibly marked in one corner and each roll at each end, with the date of manufacture and the manufacturer's name or trade mark.

F-4. *Measurements.* The representative sample shall be measured for compliance with the specified linear dimensions and thickness by means of measuring instruments having an accuracy within the limits of tolerances required by this specification.

F-5. *Flammability.* A 1 × 6 inch strip shall be subjected to flammability test as follows: The sample shall be inserted in a suitable metal frame wrapped at ³/₈-inch intervals with approximately No. 28 heat-resisting wire, as shown on Figure No. 1, so that the sample is supported throughout its entire length. One end of the frame shall be raised to form an angle of 30 deg. with the horizontal. One-fourth inch of the lower end of the material shall be bent vertically downward and the material ignited, if possible, by holding a lighted book match to the lower part of this flap for a period of 5 seconds. The time required, including the 5-second period of ignition, to burn the 6-inch strip shall be observed and shall comply with the requirements of Section E, Paragraph E-3 of this specification.

F-6. *Light transmission.* The light transmission shall be determined on a specimen of adequate size, cut from the representative sample sheet, by means of a photometer which is accurate within ±2 percent.

F-7. *Flexibility.* Three strips ½ × 6 inches shall be cut from the representative sample and tested for compliance with the specified flexibility requirements as follows: Each strip shall be cooled to 0 deg. C. and then wound in a tight compact roll on a ¼-inch rod, care being exercised to prevent slipping of the material during the winding operation. The rolled strip shall be removed from the rod and visually examined to ascertain that surfaces are free from crazes, cracks or ruptures.

F-8 *Moisture absorption.* Cut three strips 2 × 4 inches from the sample representing the lot. Dry over phosphorus pentoxide, in a vacuum desiccator evacuated to a pressure of less than 5 mm. of mercury for two hours. Remove from the desiccator and weigh. Immerse the strips in distilled water at 75 ± 5 deg. F. for 24 hours. Remove surface water, by absorbing with blotting paper or other absorbent medium and weigh. Calculate the percentage increase in weight.

F-9. *Blush resistance.* Examine the specimen, after 24-hour immersion, described in Paragraph F-8 above, for blushing (fogging). If blushing is detectable, reject the lot represented.

F-10. *Acetone solubility.* Place a strip, ¼ × 1 inch, of the material in a test tube containing 30 ml. of acetone. Cork and shake the test tube. The sample shall immediately begin to dissolve as indicated by softening and swelling.

F-11. *Shrinkage.* Dry three strips, 2 × 4 inches, of the material in a vacuum desiccator, evacuated to less than 5 mm. of mercury, over phosphorus pentoxide for two hours. Remove from the desiccator and measure the specimen with an accuracy of 0.001 inch with respect to length and width. Place the strips in an oven at 130 deg. F. and hold for one week. Remove and place in a desiccator as described above for two hours. Again measure the length and width of the specimens to 0.001 inch. Calculate change in linear measurements in percentage.

F-12. *Resistance to cracking.* Sew a circle of the material, 4 inches in diameter to a piece of 10-ounce cotton duck. The seam shall be ⅛ inch from the circumference of the test piece and sewn on a power-driven sewing machine, using a number 19 needle, making six to nine stitches per inch. Examine the stitching for radial cracks leading from the perforations of the plastic test piece. If cracks are detectable, reject the lot represented.

CWS SPECIFICATION EXCERPT, NO. 197-51-179
CASE, OUTLET VALVE, M8

C-1. *Material.* The case shall be made from virgin plastic material of uniform homogeneous composition, containing not more than 25 percent reground sprues, runners or imperfect parts of the same composition. The same type and flow numbers (same manufacturer) of molding powder shall be used for all component parts of the case.

DETAIL REQUIREMENTS

E-1. *Construction, dimensions and color.*

E-1a. *Construction.* The case shall be assembled as shown on C.W.S. Drawing No. E5-2-348 and constructed as shown on the detail drawings listed in the bill of material on that drawing. The plug (C.W.S. Drawing No. A5-2-247) shall be securely cemented to the seat (C.W.S. Drawing No. E5-2-345).

E-1b. *Dimensions.* The dimensions of the case shall conform with those shown on C.W.S. Drawing No. E5-2-348, and subsidiary detail drawings.

E-1c. *Threads.* The threads on the seat (C.W.S. Drawing No. E5-2-345) and the guard (C.W.S. Drawing No. E5-2-346) shall be smooth, clean and free from any molding fins. The guard shall be capable of being

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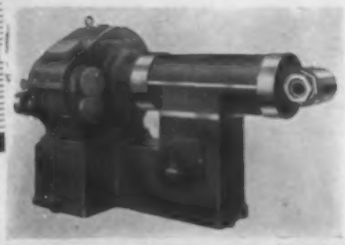

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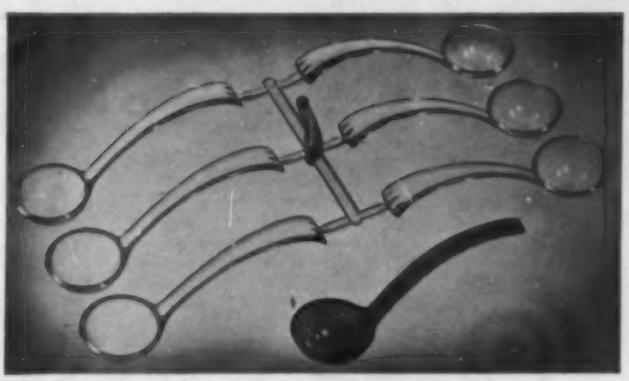

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threaded into and out of the seat with moderate hand pressure. The seat and guard shall not be bonded together in any manner.

E-1d. *Color.* The color of the case shall be warm drab No. 21 (mat finish) and shall closely approximate that color as designated on the Color Card Supplement to U. S. Army Specification No. 3-1.

E-2. *Physical requirements.*

E-2a. *Cracks.* The assembled case shall not develop cracks when alternately exposed to a temperature of −40 ± 5 deg. F. and room temperature.

E-2b. *Warpage.*

E-2b(1). *Warpage after exposure to a temperature of −40 ± 5 deg. F.* The assembled case, after being alternately exposed to a temperature of −40 ± 5 deg. F. and room temperature, shall not warp to the extent that the guard cannot be removed from and replaced on the seat.

E-2b(2). *Warpage after accelerated aging.* The case shall be disassembled and the seat and guard components shall be subjected to accelerated aging separately. After being subjected to accelerated aging, the seat and guard shall not warp to the extent that they cannot be assembled. The surface finish shall not change and the joint between the plug and the seat shall not come loose.

E-2c. *Impact.*

E-2c(1). *Impact of cases as received.* The cases, as received, shall not fracture when subjected to the impact test described in Section F, Paragraph F-4g(1) of this specification.

E-2c(2). *Impact after exposure to a temperature of −40 ± 5 deg. F.* The cases, after being alternately exposed to a temperature of −40 ± 5 deg. F. and room temperature, shall not fracture when subjected to the impact test described in Section F, Paragraph F-4g(2) of this specification.

E-2c(3). *Impact after aging.* The cases, after accelerated aging, shall not fracture when subjected to the impact test described in Section F, Paragraph F-4g(3) of this specification.

E-2d. *Rigidity of cases as received.* The case, when subjected to the rigidity test described in Section F, Paragraph F-4h of this specification, shall deflect not more than 1/16 inch.

E-2e. *Flammability.* The rate of burning of a 1 × 6-inch strip (0.014 to 0.017 inch thick) of the same material from which the cases were made, if combustible, shall not exceed six inches in 25 seconds when subjected to the flammability test described in Section F, Paragraph F-4i of this specification.

Methods of Sampling, Inspection and Test

F-1. The material and work shall be subject at all times to inspection at the place of manufacture and every facility shall be afforded authorized Government inspectors for the prosecution of their work.

F-2. *Lot size.* Unless otherwise specified, each shipment of cases shall constitute a lot. The batch runs of each lot shall be individually marked (see Section H, Paragraph H-1).

F-3. *Samples for inspection and test.*

F-3a. *Samples for inspection as to construction, dimensions, color and physical properties.* One percent of the cases of each of the first two batches and one-tenth percent of the cases in each batch thereafter, shall be taken for samples and tested for compliance with the requirements of this specification as to construction, dimensions, color and physical properties. If one percent of the cases of the first two batches or one-tenth percent of the cases in each batch thereafter is less than eight (8), cases shall be taken for samples. The tests pecimens shall be divided as follows:

50% shall be tested as specified in Paragraphs F-4a, F-4b, F-4c, F-4d, F-4h and F-4g(1).

50% shall be tested as specified in Paragraphs F-4f(2) and F-4g(3). In addition, five cases from the first batch, and five cases after each change in the formulation of the molding powder (see Section H, Paragraph H-1) shall be tested as specified in Paragraphs F-4e, F-4f(1) and F-4g(2).

F-3b. *Test strips for flammability test.* The manufacturer shall supply four (4) 1 × 6-inch test strips (0.014 to 0.017 inch thick) made from each batch of molding powder (see Section H, Paragraph H-1). The manufacturer shall certify that the test strips and the cases were made from the same batch of molding powder. Two of the test strips shall be used in the flammability test and two shall be kept for reference in case of question.

F-4. *Inspection and test.*

F-4a. *Construction.* The cases shall be visually examined for compliance with the assembly and constructional requirements.

F-4b. *Dimensions.* The cases shall be measured with suitable measuring instruments for compliance with the dimensional requirements.

F-4c. *Threads.* The cleanliness and fit of the threaded portions shall be inspected by assembling and disassembling the guard and seat.

F-4d. *Color.* The cases shall be visually examined for compliance with the color requirement.

F-4e. *Cracks after exposure to a temperature of −40 ± 5 deg. F.* Cool the assembled cases to −40 ± 5 deg. F. by any convenient method. Keep the cases at this temperature for two hours, then remove, and allow the cases to return to room temperature for two hours. Repeat this process for four complete cycles, removing no moisture from the cases during the complete test. In case a cooling solution is used, do not place the cases directly into the solution. The cases shall then be visually examined for evidence of cracks.

F-4f. *Warpage.* (*Please turn to page 114*)

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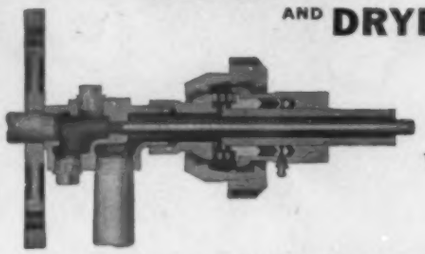

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F-4f(1). *Warpage after exposure to a temperature of −40 ± 5 deg. F.* Alternately cool and heat the cases as described in Paragraph F-4e of this specification. The cases shall then be tested for evidence of warpage by assembling and disassembling the guard and seat.

F-4f(2). *Warpage after accelerated aging.* The cases shall be aged in an air oven for 24 hours at 100 deg. F. and 100 percent relative humidity followed by 24 hours at 140 deg. F. and dry heat (desiccator) and finally 24 hours at existing room temperature and humidity. The cases shall then be tested for evidence of warpage as described in Paragraph F-4f(1) of the specification.

F-4g. *Impact.*

F-4g(1). *Impact of cases as received.* The cases, as received, shall be tested for resistance to impact as follows:

Refer to the attached sketch of the impact and rigidity testing apparatus on page 7 of this specification. Place the case, as shown on the sketch, on the supporting jig in the position shown for the impact test. Drop a ½-lb. cylindrical pellet, through a cylindrical pipe, from a height of 18 inches into the center of the case.

F-4g(2). *Impact after exposure to a temperature of −40 ± 5 deg. F.* The cases shall be alternately cooled and heated as described in Paragraph F-4e of this specification and tested as described in Paragraph F-4g(1) of this specification.

F-4g(3). *Impact after accelerated aging.* The cases shall be subjected to accelerated aging as described in Paragraph F-4f(2) of this specification and then tested as described in Paragraph F-4g(1) of this specification.

F-4h. *Rigidity of cases as received.* The cases, as received, shall be tested for rigidity as follows:

Refer to the attached sketch of the impact and rigidity testing apparatus. Place the case, as shown on the sketch, on the supporting jig in the position shown for the rigidity test. Slowly apply a load of 10 pounds on the center of the case. (Sketch obtainable from C.W.S.)

F-4i. *Flammability.* The 1 × 6-inch strips (0.014 to 0.017 inch thick) shall be subjected to flammability test as follows: The sample shall be inserted in a suitable metal frame wrapped at ⅛-inch intervals with approximately No. 28 heat-resisting wire, as shown on the attached sketch, on page 8 of this specification, so that the strip is supported throughout its entire length. One end of the frame shall be raised to form an angle of 30 deg. with the horizontal. One-fourth inch of the lower end of the material shall be bent vertically downward and the material ignited, if possible, by holding a lighted book match to the lower part of this flap for a period of 5 seconds. The time required, including the 5-second period of ignition, to burn the 6-inch strip shall be observed and shall comply with the requirements of Section E, Paragraph E-2e of this specification. (Diagram of the frame is obtainable from C.W.S.)

NOTE

H-1 A batch will consist of the cases made from one shipment of molding powder from the supplier of plastic material. The manufacturer's lot number and formulation number (molding powder) shall be supplied with the batch number.

CWS SPECIFICATION EXCERPT, NO. 197-51-180
ANGLETUBE, DIAPHRAGM, PLASTIC

C-1. *Material.* The angletube shall be made from virgin plastic material of uniform homogeneous composition, containing not more than 25 percent reground sprues, runners, or imperfect parts of the same composition. The same type and flow numbers (same manufacturer) of molding powder shall be used for all component parts of the angletube.

DETAIL REQUIREMENTS.

E-1. *Construction, dimensions and color.*

E-1a. *Construction.* The angletube shall be assembled as shown on C.W.S. Drawing No. B5-2-355, and subsidiary detail drawings.

E-1b. *Dimensions.* The dimensions of the angletube shall conform with those shown on C.W.S. Drawing No. B5-2-355, and subsidiary detail drawings.

E-1c. *Threads.* The threads on the body (C.W.S. Drawing No. C5-2-355) guard (C.W.S. Drawing No. E5-2-346), and the retainer (C.W.S. Drawing No. E5-2-354) shall be smooth, clean and free from any molding fins. The guard and retainer shall be capable of being threaded into and out of the body with moderate hand pressure. The guard and retainer shall not be bonded to the body in any manner. The threads on the retainer and the mating threads on the body shall be so registered that when the retainer is tightened against the body, the retainer shall be oriented as shown on C.W.S. Drawing No. B5-2-355 within ±5 deg.

E-1d. *Color.* (Same as for outlet valve.)

E-1e. *Leakage.* The cemented joint between the seat (C.W.S. Drawing No. E5-2-398) and the body (C.W.S. Drawing No. C5-2-353) shall not leak when subjected to a 2 pound per square inch air pressure.

E-2. *Physical requirements.*

E-2a. *Cracks.* (Same as for outlet valve.)

E-2b. *Warpage.*

E-2b(1). *Warpage after exposure to a temperature of −40 ± 5 deg. F.* (Same as for outlet valve.)

E-2b(2). *Warpage after accelerated aging.* (Same as for outlet valve.)

E-2c. *Impact.*

E-2c(1). *Impact of angletube as received.* The angletube, as received, shall not fracture nor be permanently distorted when subjected to the impact

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WANTED: Hydraulic Presses, Preform Machine and Mixer, Stainless Steel or Nickel Kettles, Vacuum Pan. No Dealers. Reply Box 275, Modern Plastics.

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FOR SALE: Five to ten thousand pounds, first reground, crystal clear injection molding Lucite Scrap. Reply Box 573, Modern Plastics.

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JOBBER WILL PURCHASE INTEREST or finance small injection manufacturing plant. Can secure sufficient business to keep plant busy and can invest sufficient capital to keep plant going. State how many machines, what types, age and capacity. Types of molds on hand if any. Strictest discretion assured. Reply Box 562, Modern Plastics.

DUE TO TRAVEL DIFFICULTIES, have you considered a Boston office to represent your interests in the New England area? Will operate on fee or commission basis. Reply Box 563, Modern Plastics.

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WILL PURCHASE 6 or 8 ounce injection molding machine, Reed-Prentice, Watson-Stillman, or Lester. Must be in excellent condition. Give full details. Reply Box 565, Modern Plastics.

WANTED: Man experienced in molding plastics, chiefly phenol-formaldehyde type, for work in plant on experimental and production work. Give references and salary expected in first letter. Reply Box 566, Modern Plastics.

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WANTED: Any make injection molding presses, preferably Watson-Stillman Model 2A, 6A, 8A or 12A, must be in good condition for purchase. Also interested in Middle-West press space. Reply Box 569, Modern Plastics.

WANTED by well established Middle-West Injection molder top operator to handle shift, give details of experience, education and state present position. State wages expected and draft status. Reply Box 570, Modern Plastics.

FOR SALE: One Ball & Jewell Standard Ideal model Patent Rotary Cutter Plastic Scrap Grinder. Capacity 150-200 lbs. per hour. One National Rubber Machinery Co. Plastic Drying Oven. Capacity 400 lbs. 8 trays. Reply Box 571, Modern Plastics.

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test described in Section F, Paragraph F-4g(1) of this specification.

E-2c(2). *Impact after exposure to a temperature of −40 ± 5 deg. F.* The angletubes, after being alternately exposed to a temperature of −40 ± 5 deg. F. and room temperature, shall not fracture nor be permanently distorted when subjected to the impact test described in Section F, Paragraph F-4g(2) of this specification.

E-2c(3). *Impact after aging.* The angletubes, after accelerated aging, shall not fracture nor be permanently distorted when subjected to the impact test described in Section F, Paragraph F-4g(3) of this specification.

E-2d. *Rigidity of angletubes as received.* The angletubes, when subjected to the rigidity test described in Section F, Paragraph F-4h of this specification, shall deflect not more than 1/16 inch when a 10-pound load is applied on the center of the guard nor more than 1/32 inch when a 10-pound load is applied to the body over the center of the retainer.

E-2e. *Flammability.* The rate of burning of a 1 × 6 inch strip (0.014 to 0.017 inch thick) of the same material from which the angletubes were made, if combustible, shall not exceed six inches in 25 seconds when subjected to the flammability test described in Section F, Paragraph F-4i of this specification.

METHODS OF SAMPLING, INSPECTION AND TEST

F-1. (Same as for outlet valve.)

F-2. *Lot size.* (Same as for outlet valve.)

F-3. *Samples for inspection as to construction, dimensions, color and physical properties.* All the angletubes shall be inspected for leakage. One percent of the angletubes in each of the first two batches and one-tenth percent of the angletubes in each batch thereafter shall be taken for samples and tested for compliance with the requirements of this specification as to construction, dimensions, color, threads and physical properties. If one percent of the angletubes of the first two batches or one-tenth percent of the angletubes in each batch thereafter is less than eight (8), then eight (8) angletubes shall be taken for samples. The test specimens shall be divided as follows:

50% shall be tested as specified in Paragraphs F-4a, F-4b, F-4c, F-4d, F-4h and F-4g(1).

50% shall be tested as specified in Paragraphs F-4f(2) and F-4g(3).

In addition, five angletubes from the first batch, and five angletubes after each change in the formulation of the molding powder (see Section H, Paragraph H-1) shall be tested as specified in Paragraphs F-4e, F-4f(1) and F-4g(2).

F-3b. *Test strips for flammability test.* (Same as for outlet valve.)

F-4. *Inspection and test.*

F-4a. *Construction.* (Same as for outlet valve.)

F-4b. *Dimensions.* (Same as for outlet valve.)

F-4c. *Threads.* The cleanliness and fit of the threaded portions shall be inspected by assembling and disassembling the body, guard and retainer. The mating threads on the retainer and body shall be inspected for proper registry by threading and tightening the retainer into the body and measuring to ascertain that the axes of the body and retainer are parallel within ±5 deg.

F-4d. *Color.* (Same as for outlet valve.)

F-4e. *Cracks after exposure to a temperature of −40 ± 5 deg. F.* (Same as for outlet valve.)

F-4f. *Warpage.*

F-4f(1). *Warpage after exposure to a temperature of −40 ± 5 deg. F.* Alternately cool and heat the angletube as described in Paragraph F-4e of this specification. The angletubes shall then be tested for evidence of warpage by assembling and disassembling the guard, retainer and body.

F-4f(2). *Warpage after accelerated aging.* (Same as for outlet valve.)

F-4g. *Impact.*

F-4g(1). *Impact of angletubes as received.* The angletubes, as received, shall be tested for resistance to impact as follows:

Refer to the attached sketch of the impact and rigidity testing apparatus, Fig. 1, on page 7 of this specification. Place the assembled angletube in the position shown for the impact test. Drop a 1/2-lb. cyclindrical pellet, through a cylindrical pipe from a height of 18 inches, on the center of the guard. Drop a 1-lb. cylindrical pellet, through a cylindrical pipe, from a height of 18 inches, on the body, over the center of the retainer.

F-4g(2). *Impact after exposure to a temperature of −40 ± 5 deg. F.* (Same as for outlet valve but referring to this specification.)

F-4g(3). *Impact after accelerated aging.* (Same as for outlet valve.)

F-4h. *Rigidity of angletubes as received.* The angletubes, as received, shall be tested for rigidity as follows:

Refer to the attached sketch of the impact and rigidity testing apparatus, Fig. 1, on page 7 of this specification. Place the angletube, as shown on the sketch in the position shown for the rigidity test. Slowly apply a load of 10 pounds on the center of the guard and then on the body, directly over the center of the retainer. (Sketch obtainable from C.W.S.)

F-4i. *Flammability.* The 1 × 6-inch strips (0.014 to 0.017 inch thick) shall be subjected to the flammability test as follows: The sample shall be inserted in a suitable metal frame wrapped at 1/2-inch intervals with approximately No. 28 heat-resisting wire, as shown on the attached sketch, Fig. 2, on page 8 of this specification, so that the strip is supported throughout its entire length. One end of the frame shall be raised to form an angle of 30 deg. with the horizontal. One-fourth inch of the lower end of the material shall be bent vertically downward and the material ignited, if possible, by holding a lighted book match to the

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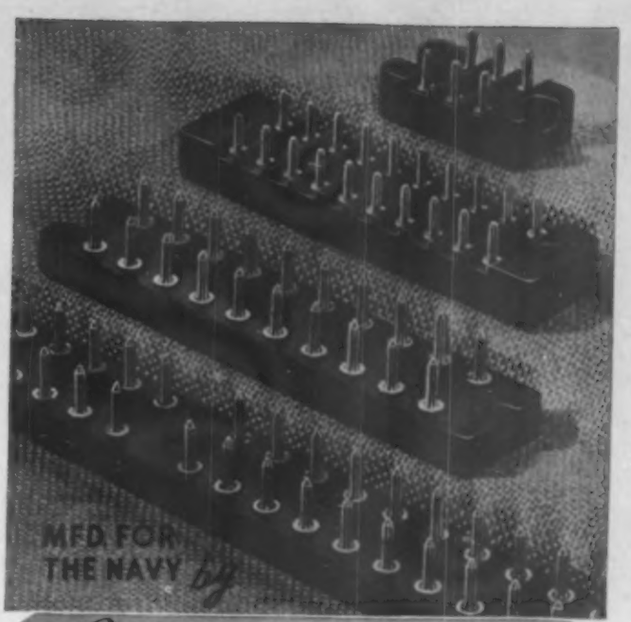

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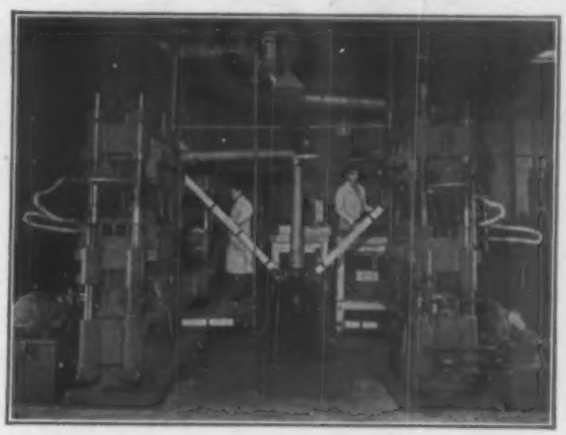

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lower part of this flap for a period of 5 seconds. The time required, including the 5-second period of ignition, to burn the 6-inch strip shall be observed and shall comply with the requirements of Section E, Paragraph E-2e of this specification. (Diagram of frame is obtainable from C.W.S.)

F-4j. *Leakage.* The cemented joint between the seat and body shall be inspected for leakage by stopping off all openings in the seat and body and applying a 2 pound per square inch internal air pressure while the body is completely submerged in water.

CWS SPECIFICATION EXCERPT, NO. 197-51-153
Y-TUBE, PLASTIC

C-1. *Material.* The tube shall be made from virgin plastic material of uniform homogeneous composition, containing not more than 25 percent reground sprues, runners or imperfect parts of the same composition.

Detail Requirements

E-1. *Construction, dimensions and color.*

E-1a. *Construction.* The tube shall be constructed as shown on C.W.S. Drawing No. E5-2-325, or No. E5-3-414 as specified in the invitation for bids.

E-1b. *Dimensions.* The dimensions of the tube shall conform with those shown on C.W.S. Drawing No. E5-2-325 or No. E5-2-414 as specified in the invitation for bids.

E-1c. *Color.* (Same as for outlet valve.)

E-2. *Physical requirements.*

E-2a. *Cracks.* (Same as for outlet valve.)

E-2b. *Warpage.*

E-2b(1). *Warpage after exposure to a temperature of −40 ± 5 deg. F.* After being alternately exposed to a temperature of −40 ± 5 deg. F. and room temperature, the Y-tube, C.W.S. Drawing No. E5-2-325 shall "go" on the gage shown on page 7 of this specification, and the Y-tube, C.W.S. Drawing No. E5-2-414, shall "go" on the gage shown on page 8 of this specification.

E-2b(2) *Warpage after accelerated aging.* After accelerated aging, the Y-tube, C.W.S. Drawing, No. E5-2-325, shall "go" on the gage shown on page 7 of this specification, and the Y-tube, C.W.S. Drawing No. E5-2-414, shall "go" on the gage shown on page 8 of this specification. The surface finish shall not change and the joints shall not come loose when subjected to this test.

E-2c. *Leakage.*

E-2c(1). *Leakage of tubes as received.* The tubes, as received, shall not leak when subjected to an internal air pressure of 5 pounds per square inch.

E-2c(2). *Leakage after exposure to a temperature of −40 ± 5 deg. F.* The tubes, after being alternately exposed to a temperature of −40 ± 5 deg. F. and room temperature shall not leak when subjected to an internal air pressure of 5 pounds per square inch.

E-2c(3). *Leakage after accelerated aging.* The tubes, after accelerated aging, shall not leak when subjected to an internal air pressure of 5 pounds per square inch.

E-2d. *Impact.*

E-2d(1). *Impact of tubes as received.* The tubes, as received, shall not fracture when subjected to the impact test described in Section F, Paragraph F-4g(1) of this specification.

E-2d(2). *Impact after exposure to a temperature of −40 ± 5 deg. F.* The tubes, after being alternately exposed to a temperature of −40 ± 5 deg. F. and room temperature, shall not fracture when subjected to the impact test described in Section F, Paragraph F-4g(1) of this specification.

E-2d(3). *Impact after aging.* The tubes, after accelerated aging, shall not fracture when subjected to the impact test described in Section F, Paragraph F-4g(1) of this specification.

E-2e. *Flammability.* The rate of burning of a 1 × 6 in. strip (0.014 to 0.017 inch thick) of the same material from which the tubes were made, if combustible, shall not exceed six inches in 25 seconds when subjected to the flammability test described in Section F, Paragraph F-4h of this specification.

Methods of Sampling, Inspection and Test.

F-1. (Same as for outlet valve.)

F-2. *Lot size.* (Same as for outlet valve.)

F-3. *Samples for inspection and test.*

F-3a. *Leakage of the tubes as received.* All of the Y-tubes, as received, shall be tested for leakage as specified in Paragraph F-4f(1).

F-3b. Same as for outlet valve except for the following:

50% shall be tested as specified in Paragraphs F-4a, F-4b, F-4c and F-4g(1).

50% shall be tested as specified in Paragraphs F-4e(2), F-4f(3) and F-4g(3).

In addition, five tubes from the first batch and five tubes after each change in the formulation of the molding powder (see Section H, Paragraph H-1) shall be tested as specified in Paragraphs F-4d, F-4e(1), F-4f(2) and F-4g(2).

F-3c. *Test strips for flammability test.* (Same as for outlet valve.)

F-4. *Inspection and test.*

F-4a. *Construction.* (Same as for outlet valve.)

F-4b. *Dimensions.* (Same as for outlet valve.)

F-4c. *Color.* (Same as for outlet valve.) (*Please turn to page 120*)

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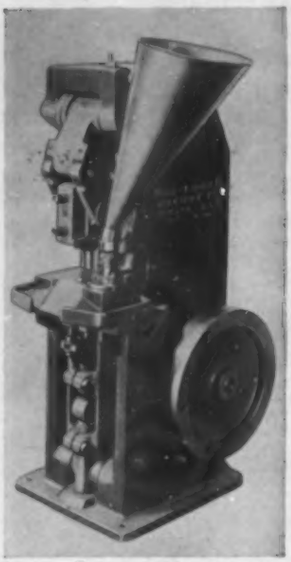

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F-4d. *Cracks after exposure to a temperature of −40 ± 5 deg. F.* (Same as for outlet valve.)

F-4e. *Warpage.*

F-4e(1). *Warpage after exposure to a temperature of −40 ± 5 deg. F.* Alternately cool and heat the tubes as described in Paragraph F-4d of this specification. The tube, C.W.S. Drawing E5-2-325, shall then be tested for evidence of warpage by placing the two legs of the "Y" simultaneously on the two 1/8-inch diameter plugs on the gage shown on page 7 of this specification. The stem of the "Y" shall then be placed on the elliptical plug on the same gage. Failure of the legs or the stem to "go" over the entire length of the respective plugs without binding shall be cause for rejection. The tube, C.W.S. Drawing No. E5-2-414, shall then be tested for evidence of warpage by placing each of the two legs of the "Y" on the 1/8-inch diameter plug on the gage shown on page 8 of this specification. The two legs of the "Y" shall then be placed simultaneously in the two slots on the same gage. The stem of the "Y" shall then be placed on the elliptical plug of the same gage. Failure of the legs or the stem to "go" over the entire length of the respective plugs and slots without binding shall be cause for rejection.

F-4e(2). *Warpage after accelerated aging.* (Same as for outlet valve, except for testing tubes as described in Paragraph F-4e(1).)

F-4f. *Leakage.*

F-4f(1). *Leakage of tubes as received.* The tubes, as received, shall be tested for leakage, by submerging in water and subjecting to an air pressure of 5 pounds per square inch.

F-4f(2). *Leakage after exposure to a temperature of −40 ± 5 deg. F.* The tubes shall be alternately cooled and heated as described in Paragraph F-4d of this specification and then tested as described in Paragraph F-4f(1) of this specification.

F-4f(3). *Leakage after accelerated aging.* The tubes shall be subjected to accelerated aging as described in Paragraph F-4e(2) of this specification and then tested as described in Paragraph F-4f(1) of this specification.

F-4g. *Impact.*

F-4g(1). *Impact of tubes as received.* The tubes, as received, shall be tested for resistance to impact by placing the tube horizontally on its three end points and subjecting it to the impact of a 1-lb. weight, 1 1/2 inches in diameter, dropped three feet, through a suitable guide, onto the center of the tube.

F-4g(2). *Impact after exposure to a temperature of −40 ± 5 deg. F.* (Same as for outlet valve but cooled and heated as described in Paragraph F-4d of this specification.)

F-4g(3). *Impact after accelerated aging.* (Same as for outlet valve but aged as described in Paragraph F-4e(2) of this specification.)

F-4h. *Flammability.* The 1 × 6-inch strips (0.014 to 0.017 inch thick) shall be subjected to flammability test as follows: The sample shall be inserted in a suitable metal frame wrapped at 3/8-inch intervals with approximately No. 28 heat-resisting wire, as shown on the sketch on page 9 of this specification, so that the strip is supported throughout its entire length. One end of the frame shall be raised to form an angle of 30 deg. with the horizontal. One-fourth inch of the lower end of the material shall be bent vertically downward and the material ignited, if possible, by holding a lighted book match to the lower part of this flap for a period of 5 seconds. The time required, including the 5-second period of ignition, to burn the 6-inch strip shall be observed and shall comply with the requirements of Section E, Paragraph E-2a of this specification. (Diagram of frame is obtainable from C.W.S.)

Sorry!

★ THE STORY ON THE ARMY HELMET LINER IN THE May issue, p. 35, should have carried a credit line stating that Durite phenol-furfural resin was used for coating the laminated fabric of which the liner was molded.

★ THE OFFICE OF THE QUARTERMASTER GENERAL has called it to our attention that some confusion may have been created in readers' minds by our story in the May issue on the Army helmet liner. The letter reads in part: "Your story on the Army helmet liner has been read with much interest. However, the emphasis in the first paragraph on page 38 of the story [on the relative positions of the high-pressure and low-pressure advocates] may lead to the mistaken impression that the Quartermaster Corps favors a low-pressure process. . ."

It was not MODERN PLASTICS' intention to suggest that these liners will be produced *only* by a low-pressure molding process; and in col. 2, p. 38, we state that other contracts have been let for liners to be molded by the orthodox, high-pressure, hardened steel die procedure, with production scheduled to start soon. Our story concerned itself solely with liners made by the low-pressure process because at the time of writing only this type of liner was in production. We plan in a future issue to discuss in equal detail liners made by the high-pressure method.

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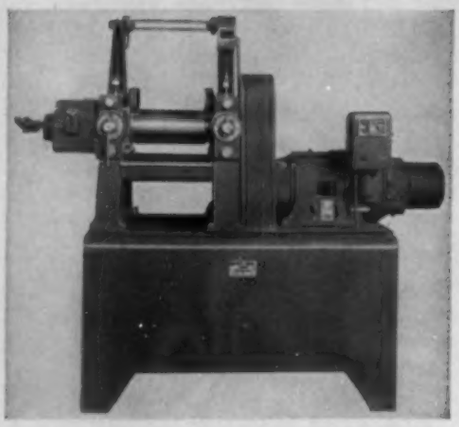

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In the plastics picture

(Continued from page 90)

★ CATALIN CORP. OF AMERICA, 101 PARK AVE., NEW York City, announces the completion of an intensive as well as extensive expansion program involving: The complete reorganization of its manufacturing facilities in the Fords, N. J., plant; the construction of a new, modern building to be devoted to the production of polystyrene molding compounds; and the purchase of land, buildings and equipment of the former U. S. Tar Products, Inc., at Matawan, N. J. In the new polystyrene plant, the first difficulties of securing processing equipment have been fully overcome, and operations are now proceeding according to schedule. Realizing, however, that the needs for synthetic rubber would affect the supply of styrene monomers, the company experimented with substitutes that have been classified as nonessential to the war effort. Several of these experiments have already proved highly successful—and of particular importance is the indication that their application will effect no impairment to high quality. At Matawan it was necessary for the company, after successfully negotiating the purchase of the above-described properties of the U. S. Tar Products, Inc., immediately to launch a reconstruction program. Four new buildings have been erected and fully equipped for the purposes intended—namely, to supply the phenol requirements necessary to the manufacture of Catalin plastics.

★ AMERICAN MOLDING CO., MANUFACTURERS OF molded and fabricated plastic products, will move to their new and larger plant at 355 Fremont St., San Francisco, Calif., some time in May.

★ SHERDYE, DEVELOPED BY SHERWIN-WILLIAMS Co., Cleveland, Ohio, is now reported in extensive use for printing on cotton textiles. This dye contains an organic pigment mixed with a synthetic resin. The pattern is printed onto the fabric and the resin welds the color to the material.

★ HOWARD W. WHITE HAS JOINED THE RESEARCH and Development Staff at Bakelite Corp., unit of Union Carbide & Carbon Corp. Mr. White is a graduate of the University of Alabama with a B.S. Degree in Chemical Engineering.

★ INDEPENDENT PNEUMATIC TOOL CO., 600 W. Jackson Blvd., Chicago, makers of Thor pneumatic and electric tools, has housed its Detroit branch in a new building of its own at 15605 Woodrow Wilson Ave. Within the past 15 months, newly constructed Thor buildings have also opened in Philadelphia, San Francisco and St. Louis.

★ PLY-RUSTEX, A CREAM PUT OUT BY THE MILBURN Co., Detroit, is for application to the worker's hands before they come in contact with highly polished metal surfaces. Said to eliminate perspiration corrosion and other forms of rust caused by the handling of metals during machining and other processing operations, it forms an invisible film on the skin which is inert with respect to chemicals, oils and cutting compounds, making the wearing of gloves unnecessary.

Sorry!

★ AMONG THE WINNERS IN THE ELEVENTH ALL-American Packaging Competition which incorporated plastics (described on page 58 of the April issue) was W. A. Sheaffer Pen Co.'s new pour-out closure for Skrip ink bottles. Unfortunately the photograph shown was of an older style of pour-out closure—although the accompanying text referred to the new closure which won a prize.

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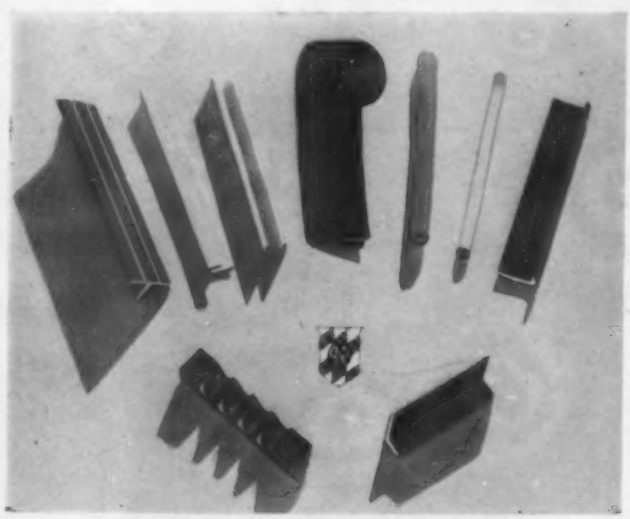

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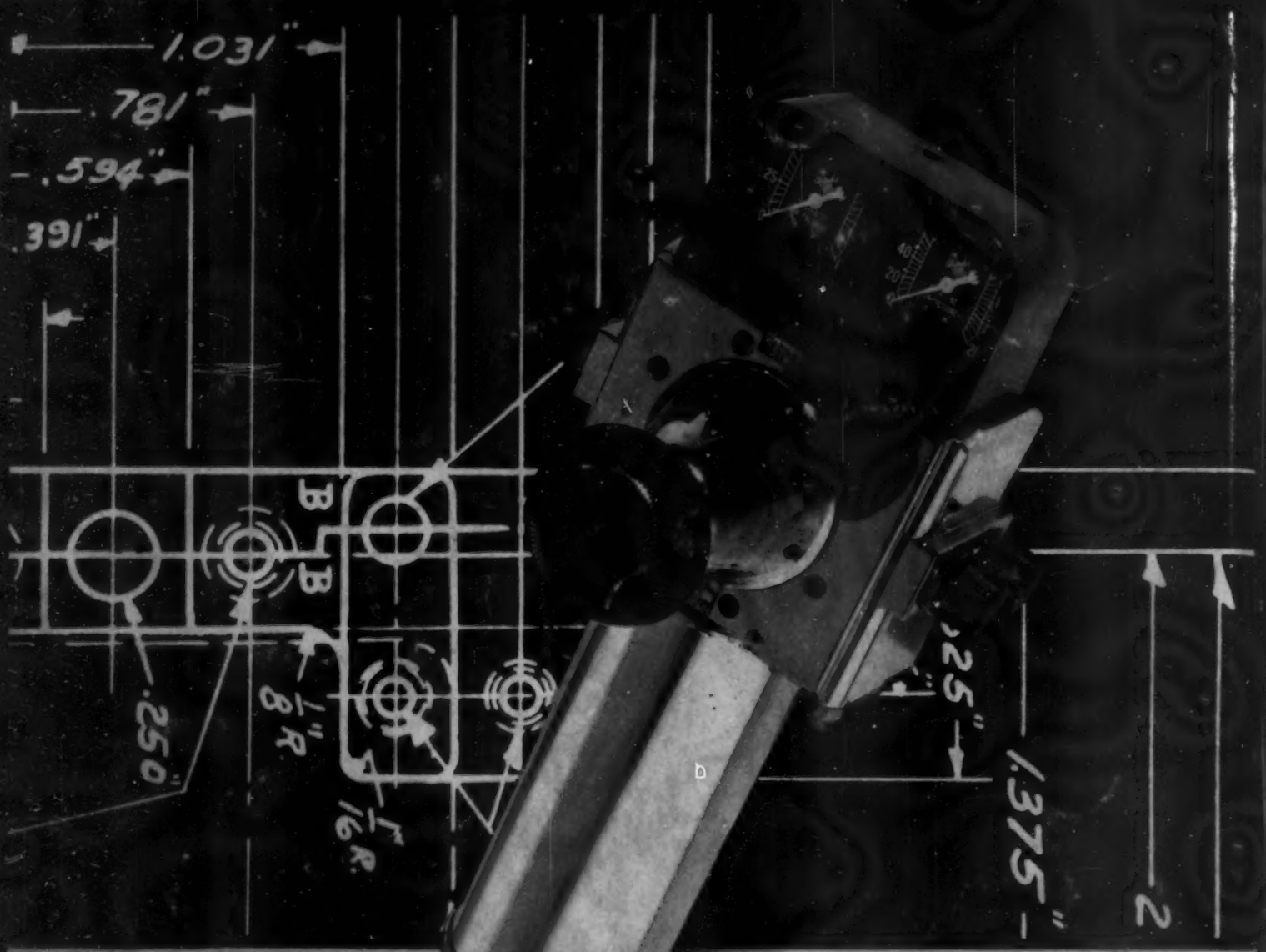

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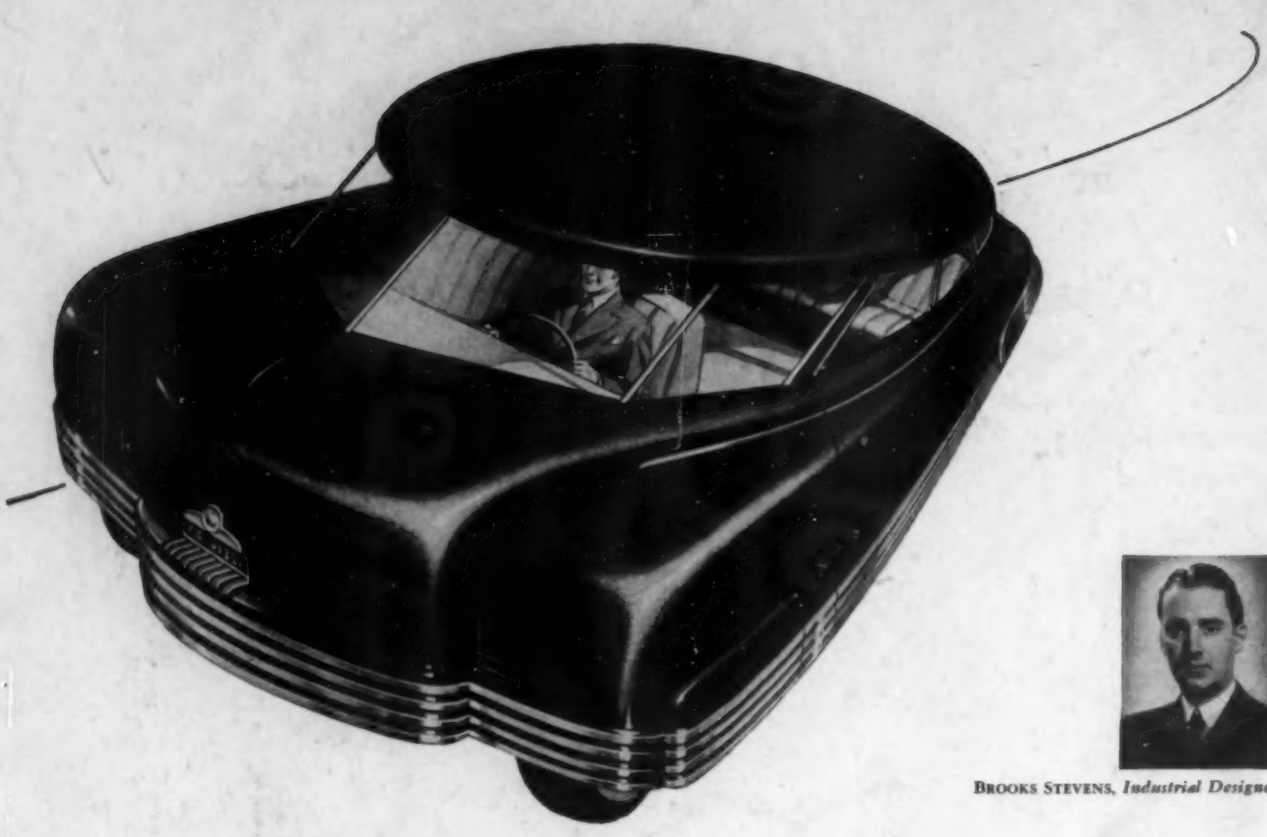

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"Motor noise will become a forgotten experience, since these phenolic plastics are non-reverberating. In many applications, paint will be unnecessary. You see... the lustrous finish obtainable with Durez plastics is part and parcel of the original molding. Even greater mass production economies can be effected. Believe you me ...these man-made plastics and resins are in the top drawer of engineers' and designers' minds... today."

With all industry humming as one arsenal... Durez plastics and resins are helping to meet the gigantic need for structural materials. Our research laboratories have a relentless taskmaster in the war effort. If you have a problem vital to America's taking the offensive... Durez engineers and chemists will be glad to go to work for you. Their long experience with plastics is at your disposal. Or perhaps you merely wish to learn more of the versatility that plastics have to offer. A request on your letterhead will bring *Durez Plastics News* to your desk.

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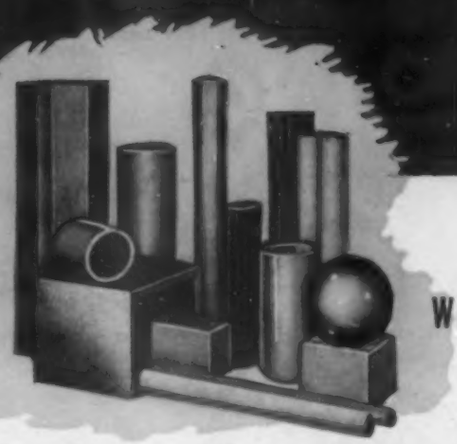

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The precision parts pictured above were readily fabricated from stock Catalin by regular machining operations. » » Catalin, a thermosetting plastic, requires no expensive, time-consuming mold construction. Small or large quantities may be produced with equal facility and economy. » » In addition to its wide selection of standard sheets, rods and tubes, Catalin's casting processes permit complete freedom of design to specifications.

» » Among Catalin's many desirable physical properties are its strength, non-inflammability, non-water absorption, and its resistance to chemicals. It is unexcelled in machinability. » » *If your requirements rate priority . . . if you must conserve vital metals, hours, dollars . . . if you are interested in prompt deliveries and responsible, capable fabricators to help you fill your needs—by all means, investigate Catalin . . . the plastic that gets things done *on time!*

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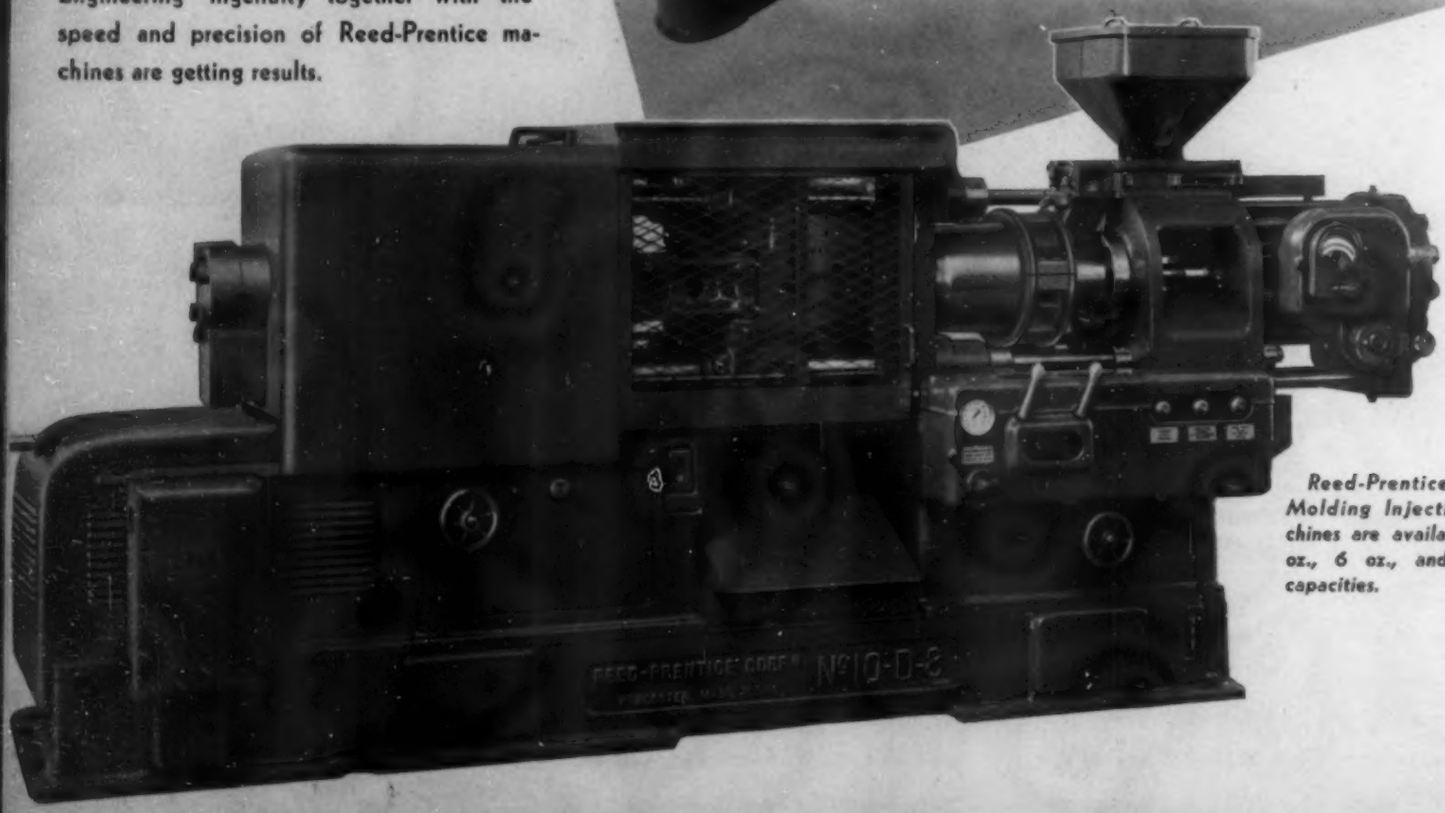
These oil bottle tops, as shown, exemplify the profit possibilities of forward looking molders. Designed and molded by Plastic Engineering, Inc., of Cleveland, Ohio, they are molded in two and four cavity molds on Reed-Prentice 4 and 8 oz. Plastic Injection Molding Machines. Made of red and blue Tennessee Eastman material, they not only present an attractive package but also conserve vital metals. Moreover, no cork gasket is required. Engineering ingenuity together with the speed and precision of Reed-Prentice machines are getting results.



Reed-Prentice Plasti Molding Injection Ma chines are available in oz., 6 oz., and 8 capacities.

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